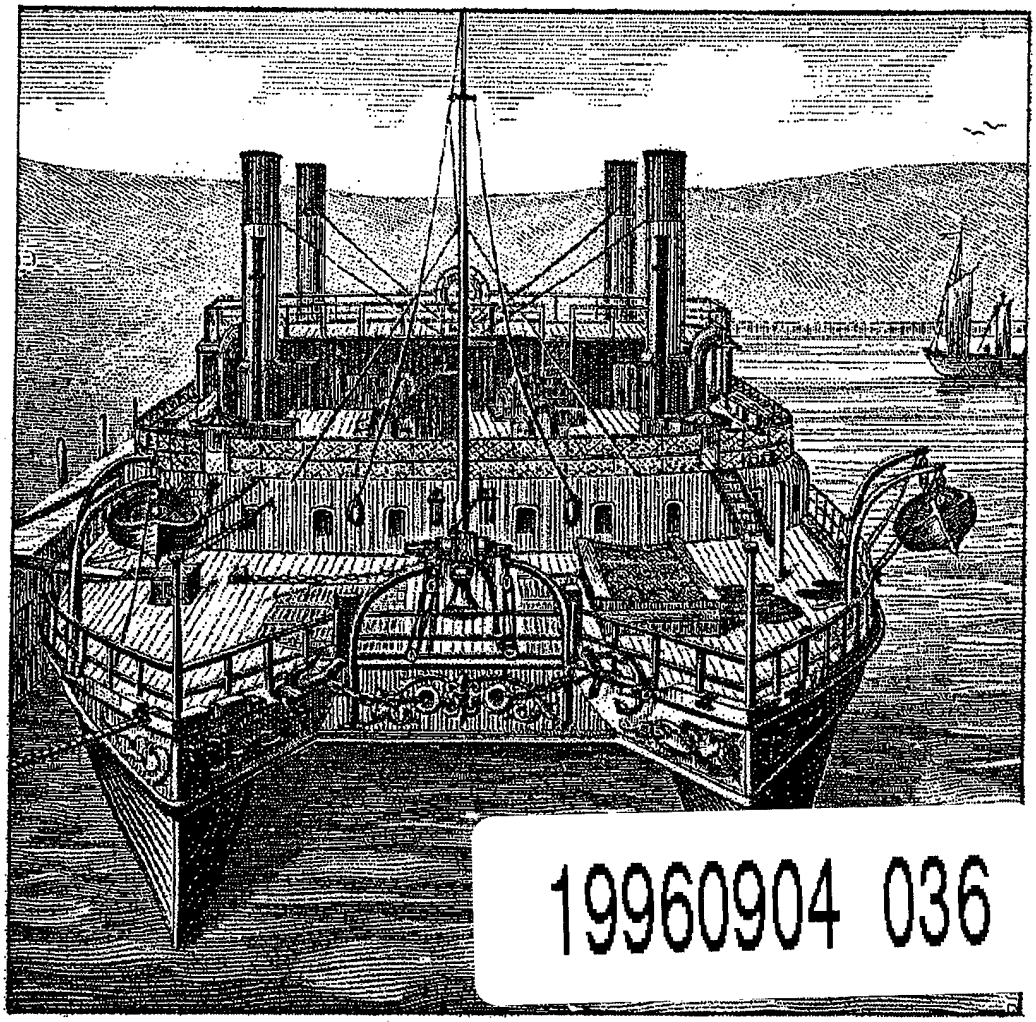
Quarterly Report

96 - GCRMTC - QR02

April 1, 1996 - June 30, 1996



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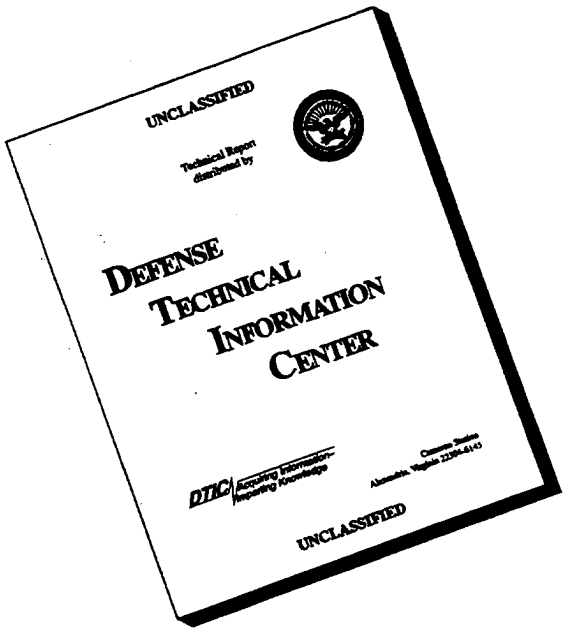

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GULF COAST REGION MARITIME TECHNOLOGY CENTER

QUARTERLY REPORT

96-GCRMTC-QR02

Cooperative Agreement N00014-94-2-0011

REPORT PERIOD: Apr 1, 1996 - Jun 30, 1996

SUBMITTED TO: Mr. Dale Rome
Director
Shipbuilding Technology Office
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Naval Surface Warfare Center

SUBMITTED BY:
Gulf Coast Region Maritime Technology Center
New Orleans, LA

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EXECUTIVE SUMMARY

The Gulf Coast Region Maritime Technology Center (GCRMTC) was initiated September 26, 1994 and is now fully operational. The infrastructure buildup consisting of renovation of facilities and initial acquisitions of research equipment, computer hardware and software is complete. The Center has filled all its positions at both sites (Orange Site and New Orleans Site). The Center has been designated as a Navy Center of Excellence in Advanced Marine Technology.

Based on the May 1995 Government/Industry Advisory Board (GIAB) recommendations and approval of the Government Program Manager (GPM), the Center issued five Requests for Proposals. The proposals along with Center recommendations and rankings were submitted to the GPM. The following proposals were approved for funding and the Center has negotiated and awarded contracts effective June 1, 1996:

1. Automated Machine Learning of Diesel Engine Operating Characteristics
2. An Investigation of the Expansion of the GCRMTC Ships' Reliability, Availability and Maintainability (RAM) Database
3. Development of a Portfolio of Ship Designs
4. Automated Off-Line Programming: A Strategic Tool to Link the Design and Manufacturing Processes

The Center issued a second solicitation for Concept Proposals in August 1995 from the marine industry and from university researchers. Based on peer reviews, GIAB recommendations and GPM approval, three requests for proposals were issued in late April 1996. A third solicitation for Concept Proposals (both internal and external) was issued in January 1996.

The GCRMTC initiated the Environmental Resources and Information Center (ERIC) and the Simulation-based Design Center (SBDC) in 1995. The ERIC, which is colocated at the New Orleans Site is a depository and resource for environmental issues of concern to the shipbuilding/marine industries. ERIC is fully operational, and its operations and services are fully detailed on the World Wide Web. The SBDC is colocated at the Orange Site and is fully operational. The SBDC has initiated several collaborative projects with selected NSRP Panels and shipbuilding/marine industries.

Status reports on 18 collaborative research projects being conducted at both sites are appended for reference. Research projects being conducted at both sites are in collaboration with shipbuilding/marine industry partners.

The Center was a cosponsor in the development of the National Shipbuilding Display Booth which was exhibited at the American International Shipbuilding Exposition in April in New Orleans. The Center plans to set up an exhibit at the Shipbuilding Machinery and Marine Technology Exhibition and Conference (SMM '96) in Hamburg, Germany in October.

GCRMTC QUARTERLY REPORT
April 1 - June 30, 1996

1. INTRODUCTION

The Gulf Coast Region Maritime Technology Center (GCRMTC) was initiated September 26, 1994 and is now fully operational. The Center has been designated as a Navy Research Center of Excellence in Advanced Marine Technology.

As part of the Center's mission, research is carried out at both its New Orleans Site and its Orange Site. The Orange Site, originally administered by Lamar University, is now administered by the University of New Orleans.

The Center also solicits concept ideas for collaborative research from maritime industries and then issues Requests for Proposals (RFPs) under the guidance and direction of its Government/Industry Advisory Board (GIAB) and the Government Program Manager (GPM). All research projects sponsored by the Center at both its Sites is collaborative research with marine industry partners.

2. CONCEPT PROPOSAL SOLICITATION

In August, 1995, the Center sent out a second solicitation for Concept Proposals to over 375 industry and academic sources. Approximately 50 responses were received and processed through an external peer review process. The results of the peer reviews along with Center recommendations were presented to the GIAB on December 7, 1995. The external Concept Proposals approved by the GIAB were submitted to the GPM, along with rankings and recommendations for consideration for issuance as RFPs.

In January 1996, another solicitation for Concept Proposals (both internal and external) was sent to over 300 addressees. These Concept Proposals were peer reviewed and the results were presented to the Government/Industry Advisory Board (GIAB) in May, 1996.

A master schedule (Appendix A) depicts time frames for both the RFP and Concept Proposal Solicitations and other events pertaining to the Center and its New Orleans and Orange Sites.

3. 1996 MARINE INDUSTRY PROPOSALS

Based on the May 1995 recommendations of the GIAB regarding Concept Proposals, the Center formulated requests for proposals (RFPs), and obtained the approval of the Government Program Manager (GPM) to issue RFPs in the following areas:

1. Automated Machine Learning of Diesel Engine Operating Characteristics
2. An Investigation of the Expansion of the GCRMTC Ships' Reliability, Availability and Maintainability (RAM) Database
3. Development of a Portfolio of Ship Designs
4. Automated Off-Line Programming: A Strategic Tool to Link the Design and Manufacturing Processes
5. Establishing a Benchmark for Worldwide Marine Machinery and Equipment Manufacturing

Proposals were submitted in response to the RFPs and were peer reviewed. The proposals along with Center recommendations and rankings were submitted to the GPM for approval on December 18, 1996. The GPM has reviewed the recommendations and notified the Center of his approval for funding in the first four areas listed above. The Center negotiated contracts with the individual maritime industries for these four areas and awarded the contracts in June 1996.

Concept proposals (internal) at the New Orleans Site that were approved by the GIAB were converted into full research proposals (in order of priorities and consistent with available funding) and presented to the GPM for final approval and funding. The GPM approved, subject to refinement, internal proposals, on both new and continuing projects, on December 22, 1995. A list of the approved internal proposals on both new and continuing projects is shown in Section 6.1 (New Orleans Site). He also approved external Concept Proposals which were issued as RFPs by the Center in late April 1996 in the following three areas:

1. A Case Study of Dimensional Analysis Effects on Structural and Outfit Design Production.

2. Second Generation Data Collection Module Development and Rollout for the Ship Operations Cooperative Program's (SOCPs) Reliability, Availability, Maintainability (RAM) Database.

3. Design, Fabrication and Testing of Fire-Tolerant Composite Structures for Commercial and Navy Uses.

Four proposals have been received in response to the RFPs and are being submitted for peer review evaluation at present.

4. AMERICAN INTERNATIONAL SHIPBUILDING EXPOSITION AND GOVERNMENT-INDUSTRY ADVISORY BOARD MEETING

In April 1996, the Center, New Orleans Site and the Orange Site set up and staffed two booths at the American International Shipbuilding Exposition which was held in New Orleans.

Preparations were made during this quarter for the May 1996 GIAB meeting, which was held in New Orleans. As stated earlier, results of the Concept Proposal peer review were presented for the Board's review and recommendations.

5. GCRMTC CENTERS

The GCRMTC has initiated three sub-Centers — Simulation-Based Design Center, Shipbuilding Environmental Resource Center, and a Marketing Resource Center. The Simulation-based Design and Environmental Resource Information Centers are fully established. The Marketing Resource Center is in the formative stage at present.

5.1 GCRMTC Environmental Resource Information Center (ERIC)

ERIC was established to address the environmental issues of the shipbuilding industry. It assists with matters pertaining to the planning and implementation of environmental and health related methodologies by providing ready access to available sources of information and resident expertise. ERIC facilitates the collection and distribution of technical and regulatory information within the industry.

5.1.1 ERIC's On-Going and Rapid Response Activities

Document Maintenance and Collection -

ERIC maintains hard copies of all NSRP reports dealing with environmental issues, and copies of SP-1 Panel progress reports, and most memoranda, hand-outs and other material distributed by mail or at meetings. This information is used to prepare the SP-1 Panel Newsletter and can be copied for distribution to members. The SP-1 Panel Newsletter and the ERIC Newsletter are both available from ERIC through the WWW.

In addition, ERIC maintains current federal and state regulatory information through the Bureau of National Affairs, Inc. "Environmental Reporter" and electronic files. An effort is also being made to expand the UNO collection of information on pollution prevention technologies. Also, ERIC's staff can conduct literature searches of several pollution prevention databases.

NSRP SP-1 and SP-3 Liaison -

ERIC's personnel continue to participate in NSRP's SP-1 and SP-3 Panel activities. During this quarter the efforts were directed toward the development of the first SP-1 Panel Newsletter which was distributed to NSRP members prior to the next Panel meetings in Norfolk, VA. Proposed sub-tasks under the Environmental Studies and Testing Project have been reviewed and tasks of mutual interest identified. Joint support of one or more of these sub-tasks will be proposed at the next SP-1 Panel meeting in mid-July.

ERIC personnel have also maintained contact with and an interest in the environmental/health related projects being developed by the SP-3 Panel. A number of the FY-97 project ideas are compatible with ERIC's mission and interest. For example, the elimination of blast media and paint flakes in surface preparation increases efficiency and reduces waste in painting activities. ERIC staff will be attending the SP-3 Panel July meetings in Norfolk, VA.

Industry Position on Pending OSHA Hexavalent Chromium Standards -

The report titled "Impact of Anticipated OSHA Hexavalent Chromium Worker Exposure Standard on Navy Manufacturing and Repair Operations" prepared by the Navy/Industry Task Group is being used to prepare a journal article. The purpose of the article is to inform and promote interest in the scientific community for exploring methods and seeking a means for evaluating the effects and controlling Cr(VI), Manganese and Nickel from welding fumes.

A survey of available equipment for the extraction and control of welding fumes is being conducted. Equipment suppliers from Europe and the U.S. were contacted for information. Equipment specifications are being established and will be available for future use in research to evaluate the compliance with proposed OSHA limits on hexavalent chromium (Cr(VI)).

Development and Support for GCRMTC Research on Air Emission Levels -

As a result of its participation on the Navy/Industry Task Group studying the impact of the proposed OSHA standards for Cr(VI) and other air emission pollutants involved in ship fabrication and repair, ERIC has identified this topic as a priority and has supported research proposals submitted for funding through the Gulf Coast Region Maritime Technology Center. The GCRMTC has approved funding and has initiated a study on "Evaluation of Hexavalent Chromium Exposure Levels in the Shipbuilding Industry."

EPA's Environmental Leadership Program

ERIC's staff continues to maintain a liaison function with the EPA's Environmental Leadership Program (USEPAELP) through participation on the multiagency team overseeing the USEPAELP project at the CibaGeigy Co. Plant in St. Gabriel, LA. ERIC was represented and has participated in the three-day review meetings held at the plant and has reviewed the plant's

environmental management systems, its multimedia compliance assurance program, and its community outreach program. ERIC personnel also participated in an EPA effort to develop a framework for the total program that is to be distributed to states and facilities around the country to facilitate the development of more effective Pollution Prevention programs. ERIC's efforts are directed at determining the impact of these types of programs on the shipbuilding and repair industry.

ERIC Toxic Release Inventory Hazard Value Model

A PC program based on the University of Tennessee's Center for Clean Products and Clean Technologies chemical rating and scoring method developed for the EPA is now available from ERIC. The ERIC program calculates a "TOTAL HAZARD VALUE" for TRI chemicals to better assess the potential human health and environmental impacts of a facility's emissions. The program can also be used to calculate the THV of individual or groups of compounds, and the THV of all compounds released by a facility or industry. Copies of the program disk are also available.

5.1.2 Educational Programs

Workshops -

Two workshops are being developed for the next quarter, one on ISO 14000 and one on the EPA's Common Sense Initiative (CSI) and Project XL. These workshops will focus on the potential impact of these initiatives on the shipbuilding and repair industry. While CSI and Project XL focus on approaches that will provide "Cleaner, Cheaper and Smarter" regulatory systems, ISO 14000 is an international program designed to establish an effective environmental management system that can be integrated with other management requirements to assist organizations to achieve environmental and economic goals.

Review of Format and Workshop Topics

A review of the responses to questionnaires distributed at the first two workshops indicated strong support for continuing the program with a focus on timely environmental topics, particularly regulatory in nature. The format employed was, in general, found to be favorably accepted with requests for more handouts, particularly of the slides used in the presentations. It is anticipated that the topics and format used in these workshops will work well in other areas of the country. A national survey of the shipbuilding and repair industry failed to establish a need for training courses. However, workshops covering timely regulatory issues appear to be of interest to the industry based on the response to the last two ERIC workshops. We will continue to investigate the possibility of offering similar workshops in other areas of the country possibly in cooperation with SP-1 Panel.

5.1.3 Visibility, Communications and Industry Participation

Mailing lists from various sources have been integrated into a national list of shipbuilding and repair facilities in the United States. Facilities in the southeastern region of the United States were contacted by telephone to confirm addresses, contacts, telephone and FAX numbers. A similar survey will be conducted on other regions with high concentrations of shipbuilding and repair facilities. The mailing list will be used to distribute ERIC and SP-1 Panel Newsletters. The latter was distributed to the NSRP mailing list obtained from NASSCO.

Industry Network Development -

In addition to other industrial and community contacts, ERIC provided a display of its activities in the June Meeting of the "State of the State Workshop" sponsored by the Environmental Research Coalition of Louisiana. The workshop was held at Louisiana State University in Baton Rouge.

ERIC's WWW Page -

The ERIC WWW page has been expanded to include the ERIC and SP-1 Panel Newsletters, and current regulatory highlights of importance to the shipbuilding and repair industry. Abstracts of GCRMTC environmental project reports will be included as the reports become available. The SP-1 Panel Newsletter contains status reports of current projects as well as a list of proposed projects. The ERIC WWW page is accessible through Internet at http://www.uno.edu//~engr/eric.html.

Regulatory Update: Economic Instruments for Environmental Regulation -

A compilation of technical documents describing market based instruments for pollution control and monitoring has been initiated. Several documents published on this topic by the Organization for Economic Cooperation and Development, and by other institutions were reviewed. Of special interest is the possibility of using these instruments as an alternative to Administrator Browner's Common Sense Initiative for the shipbuilding industry. Additional publications from OECD, the World Bank, the Intra-American Development Bank, and the EPA will be purchased for ERIC's library, and will also be reviewed.

5.1.4 ERIC's NSRP SP-1 Activities

SP-1 Newsletter -

In June, ERIC produced and mailed the first issue of a new NSRP Panel SP-1 Newsletter to more than 300 constituents. ERIC's objective was to deliver it before the July 15, 1996 SP-1 Panel meeting in Norfolk. ERIC's staff members attending that meeting will hand out extra copies to all interested parties.

The Newsletter is an important step in Panel SP-1's strategic plan to improve its visibility and communication with other NSRP Panels, ECB, U.S. shipyards and other interested groups. Since only a small percentage of shipyards in the U.S. are represented on the SP-1 Panel, a long-term goal of the Panel is to provide information to the Tier 2 shipyards and other smaller members of the industry.

The Newsletter will be published several times a year by ERIC, and contains information on SP-1 Panel Projects, regulatory issues, interim reports on selected projects and other pertinent topics.

SP-1 Panel Activities -

5.1.5 Work Plan and Activities Proposed for Next Quarter

Maintenance and collection of selected reports and documents from NSRP, EPA and other.

Continue dialogue with NSRP SP-1 and SP-3 Panel activities and seek opportunities for mutual projects.

Participate in SP-1 Panel meetings during the July Norfolk, VA meeting.

Presentation of two or more workshops and development of other topics of environmental issues of interest to the industry.

Publish several technical bulletins, tentatively titled ERIC *Reports* , on selected topics and projects of current interest.

Continue to expand and enhance ERIC's Website.

5.2 Simulation Based Design Center

5.2.1 Regional

LPD-17 Project Model Visualization

The Orange site is continuing to develop an immersive model of the LPD-17. The Intergraph workstation and other resources have been used to develop the immersive model. The staff has had discussions with Silicon Graphics and CadCentre regarding the maturation of their Review Reality software. This software allows the extraction of Intergraph formatted product model data and design review on the Center's Power Onyx.

Prior experience with this software showed some problems related to its development. However, current reports indicate that data are extracted from Intergraph software with no errors and that the CadCentre software enables extremely large models to be reviewed. In conversations with representatives of Brown & Root who are evaluating this software for its A/E/C design review, an entire process plant product model developed in Intergraph's Plant Design System has been tested.

CadCentre currently operates a "Reality Center" in the UK and has worked with the Orange Site to demonstrate applications of visualization to Chevron Offshore project management and Brown & Root. It appears to be in the best interests of the Orange Site to consider further testing and to possibly acquire the Review Reality software to support the LPD-17 procurement and subsequent Navy design programs.

Application of SBD to MOBS Project

At the request of McDermott, the Orange Site submitted a proposed scope of work in support of the MOB design effort. This proposal provided for the visualization of design options and simulations to be used to evaluate concept options. The planned start date for the project is currently in August. Significant in the site's support of McDermott was its demonstration of the data conversion path from FORAN to other formats. The design work will be done using this software at McDermott Shipbuilding and exported for simulation and visualization.

SBD as an Environment for Concept and Contract Design Using IPPD

The Orange Site participated in development of this proposal during the previous quarter with Avondale serving as the lead organization. The other participants besides Avondale Industries and the GCRMTC are Intergraph Corporation, General Dynamics Electric Boat Corporation, and the Institute for Competitive Design.

A project plan was released by Avondale and the project initiation is set for the week of July 15, 1996 with Orange personnel and UNO personnel attending two days of IPPD training and three days related to defining the scope of work for the project. The project will be revised and updated based on this and subsequent meetings. The subcontract between Avondale and the GCRMTC is pending.

Development of an Integrated Product and Process Data Environment to Revolutionize Shipbuilding Processes

The Orange Site was included in this proposed project as a technology demonstration site. Among other members of the team are Hughes Aircraft, Advanced Marine Enterprises, Orincon Corporation, Intelligent Systems Technology and the American Bureau of Shipping. This project is being led by Hughes Aircraft with Avondale, Intergraph, and Bath participating.

Hughes is currently in negotiations with Maritech regarding the scope of work. Orange Site personnel have been working closely with Hughes which is a newcomer to the marine industry.

In this respect, the Orange Site is able to provide expertise and insight in the application of the satellite-based network technologies to this industry.
The start-up was originally scheduled in June. A project schedule has not been released pending negotiations and inclusion of shipyard partners. The Orange Site's role in this project is still to be defined beyond a general inclusion. Follow on meetings between the Orange Site and Hughes will be scheduled. During the first full week in July, a meeting will take place among the consortium members with the actual project kickoff meeting for the full project team planned for July 15 or 16.

5.2.2 National

Lockheed Simulation-Based Design Program

The Orange Site is currently using the Virtual Design Environment (VDE) Release 1.0 software. Orange personnel attended the first Simulation-Based Acquisition Workshop in May. Another is scheduled for July and Orange personnel attendance has been requested.

McDonnell Douglas Implementation of Newport News Smart Product Model

James Rossie from McDonnell Douglas paid the Orange Site a visit in May. McDonnell Douglas is developing a contract proposal at the request of Gary Jones to demonstrate the application of the Newport News Smart Product Model to aircraft design. In order to support Mr. Jones' schedule, they must have this under contract by July. McDonnell Douglas intends to have GCRMTC/Orange provide some support to them under a subcontract. Orange Site support is not yet defined.

Shipbuilding Ventures Inc. 40,000 DWT Tanker:

The Orange Site involvement is complete and the site is currently using its experience related to this project in support of other Orange Site activities. A parametric solid model of the Skarhar midship section which was developed by Dr. Paul Corder is available. An open inventor format model of the entire ship was provided by Landon & Associates. These will be used in work with ABS.

5.2.3 Development of SBD Projects

Distributed Collaborative Design -

American Bureau of Shipping (ABS): ABS senior management have visited the Orange facility and observed the technology demonstration at the AISE. ABS personnel also participated in a demonstration of collaborative design review at the AISE. As a result, the Orange Site has been working with ABS in Houston to identify areas of investigation that will reduce the time for design review and approval. Such areas include electronic submittal of drawings, use of collaborative design technologies (such as e-mail, the Internet, video-conferencing, shared work

electronic spaces, etc.), review of 3 dimensional CAD models, and validation of product model data.

Chevron Offshore: Chevron requested a demonstration of the Center's visualization technology and provided the Center with a model of an offshore platform. The Center then converted the model, created the visualization, and returned 20 minutes of video tape of a walk through of its platform within 24 hours. The Center also demonstrated the use of Internet-based technologies for design and remote collaboration. The Chevron management then subsequently visited the Orange Site. Further, Chevron included the Center's video tape and another tape which showed a walk through of its proposed Green Valley project at the Board of Directors meeting in San Francisco.

Brown & Root: Brown & Root has advised the Center that it is interested in adopting SBD technology in its design and engineering operations. Further discussions with Brown & Root management are in the planning stages.

6. NEW ORLEANS SITE ACTIVITY REPORT

6.1 In-House Research Projects

Currently there are 13 research projects in various stages of progress. Quarterly reports of these research projects are attached as appendices to this report and listed below (projects in *italics* commenced in January 1996):

GCRMTC Project No.	Title	Appendix
AMTC95-001A	Inexpensive Non-Toxic Pigment Substitute for Chromium in Primer for Aluminum Substrate	B
AMTC95-008A	Integrated Environmental Management Plan for Shipbuilding Facilities	C
AMTC95-010A	UNO-Swiftships Development of a Cost Effective Aluminum Catamaran Structure	D
AMTC95-014A	Applications of Integrated Optical Fiber Sensor Systems in Shipbuilding and Shipboard Monitoring	E
AMTC95-016A	Research in Shipboard Sensors	F
AMTC95-018A	Ships' Reliability, Availability, and Maintainability (RAM) Database	G
AMTC95-027A	Software Applications for Shipbuilding Optimization	H
AMTC95-030A	Improving Technology in the Shipbuilding Industry	I
AMTC95-035A	Digital Image Photogrammetry	J
AMTC95-036A	Ship Capsizing (an Accurate and Efficient Technique to Predict Ship Roll Damping)	K
AMTC96-032A	*Evaluation of Cr(VI) Exposure Levels in the Shipbuilding Industry*	L
AMTC96-033A	*Integrating Fire-Tolerant Design and Fabrication of Composite Ship Structures*	M
AMTC96-041A	*Shock Reduction of Planing Boats*	N

6.2 Sub-Contracted Research

Based on the proposals submitted in response to RFPs issued in July 1995, contracts have been awarded by the GCRMTC effective June 1, 1996 as follows:

Title	Contractor
1. Automated Machine Learning of Diesel Engine Operating Characteristics	**MACSEA Ltd.**
2. An Investigation of the Expansion of the GCRMTC Ships' Reliability, Availability and Maintainability (RAM) Database	**Rockwell International**
3. Development of a Portfolio of Ship Designs	**Rosenblatt & Son, Inc.**
4. Automated Off-Line Programming: A Strategic Tool to Link the Design and Manufacturing Processes	**CYBO Robots, Inc.**

6.3 Infrastructure Build-up Status

The bulk of the infrastructure equipment directly associated with the first phase of ongoing research projects has been received or has been ordered. Some of the infrastructure equipment planned for the Center/New Orleans Site has been held in abeyance due to uncertainties involving receipt of appropriations.

6.4 Education and Training

Two regional workshops are planned for New Orleans as discussed in section 5.1.2. A representative from Concurrent Technologies Corporation visited New Orleans and participated in discussions with the GCRMTC relative to establishing educational courses for shipyards in the Louisiana/Mississippi area. A survey was conducted to establish the workshop needs in the maritime industries.

Biweekly seminars are continuing to be held on the research projects in progress. Two projects are presented at each seminar. The primary goals of the seminars are to a.) inform the PIs and their researchers about all the ongoing research and b.) to encourage interactions and exchange of ideas among the researchers and their industry collaborators.

6.5 American International Shipbuilding Exposition (AISE)

The Center, New Orleans Site, and the Orange Site set up and staffed an information booth at the AISE Exposition on April 11-13, 1996 in New Orleans. Graduate students were provided by the New Orleans Site in connection with the GCRMTC's joint sponsorship of a MARITECH booth at the Exposition.

7. ORANGE SITE ACTIVITY

The Orange site has continued to pursue activities consistent with the objectives identified in its mission and has successfully developed relationships with the marine industry and technology sources. The staff is developing its expertise and experience.

The final reports from OR95-003C Japanese CIMS Translation Project and OR95-002B Ship Repair Market Study have been forwarded to the Executive Director of the GCRMTC. The first drafts of the OR95-005A Marketing Resource Center Feasibility Study and OR95-001A Business Process Improvement Gulf Copper Manufacturing, Inc. are complete. The final drafts will be prepared after comments are received, reviewed, and incorporated.

The Orange Site has met with the team members for the Maritech projects in which the site is included. The Orange Site is a participant in the *SBD as an Environment for Concept and Contract Design Using IPPD project* which includes Avondale Industries, Intergraph Corporation, General Dynamics Electric Boat Corporation, and the Institute for Competitive Design. The Orange Site is also included in the project entitled *Development of an Integrated Product and Process Data Environment to Revolutionize Shipbuilding Processes* which includes Hughes Aircraft, Advanced Marine Enterprises, Avondale, Orincon Corporation, Intelligent Systems Technology, and the American Bureau of Shipping.

The Orange Site continues to participate in the simulation-based design program with Lockheed Martin, NAVSEA, and other members of the team. A proposal has also been submitted for inclusion in the Mobile Offshore Base design project with McDermott Shipbuilding and Hudson Engineering. The Orange Site also participated in the May Simulation Based Acquisition Workshop held in Washington DC in May.

The Site continues to develop its relationships with industry partners and technology sources. Project concepts are being explored with the American Bureau of Shipping, Ingalls Shipbuilding, and Avondale Industries. Also, applications of available technologies are being discussed with CadCentre, Deneb, SDRC, and Computervision.

The following activities were completed during the last quarter:

7.1 Software

The Orange Site has upgraded its software to the latest versions. The site is currently running ProEngineer R16, ANSYS R5.2, Vislab R1.4.2, dVise R3.01, Fastship R5.01, ADAMS R8.2, and Autoship R6.01. A copy of Computervision's model viewer for use in working with Ingalls Shipbuilding has been installed.

7.2 Technology Development

7.2.1 Regional

Development of Billing Software for Distributed Computing Environment

This project is complete. See the attached progress report (Appendix O)

7.2.2 National

Simulation of Outfitting Processes in New Ship Construction (proposed)

The project "Simulation of Outfitting Processes in New Ship Construction" has been submitted to the GCRMTC Executive Director for his review and action. Currently the project has been reviewed by ONR support staff, GCRMTC-Orange staff, and the site manager. Suggestions regarding the designation of this project as an "in-house" rather than external activity have been raised. Other issues which have been raised throughout the development of this proposal have been considered and, where and when appropriate, modifications to the proposal have been made. Avondale Industries has agreed to be the maritime industry partner for this project.

This project will focus on four major business units for baseline modeling: machinery, pipe fitting, electrical, and sheet metal. The project will demonstrate current work processes and challenge basic assumptions of the execution of work. Simulation will allow comparing and contrasting of "what if" scenarios to pinpoint developmental areas and opportunities for improvement in the outfitting process in new ship construction. Additionally, the project will endeavor to reduce the risk and cost associated with innovation.

The project will be discussed at an upcoming planning session; concerns will be addressed. The Orange Site will continue to communicate with Avondale and the proposal authors to remedy any concerns.

7.3 Testing of Ships, Ship Systems, and Shipbuilding Technology Improvements

7.3.1 Regional

Ship Repair Business Process Improvement

This project is complete. See the attached progress report (Appendix P)

7.3.2 National

National Shipbuilding Network

Using a model provided by Proteus Engineering, a demonstration of the use of Web-based visualization was developed to access a distributed vendor database over the Internet. This was

done by creating a VRML model of a diesel generator set then assigning links to the American International Shipbuilding Exposition (AISE) "Connect with the World" database of vendors. The vendor database created during the AISE allows listing of the vendor, resources available, and other related information. From that database, connections can be made to the vendors' Internet site. By extension, this would allow browsing of on-line vendor catalogues, exchange of design and cost information, and other information needed by shipyards.

7.4 Education

7.4.1 Regional

Access to the Orange Site is available through ordinary Internet connection. Efforts are still underway to connect the New Orleans Site at the University of New Orleans via a T-1 link. This task is expected to be completed by the end of August, 1996.

The Orange site has also made its resources available to the University of Michigan, and on a test basis with Vibtech Engineering and M. Rosenblatt and Son Naval Architects and Marine Engineers. Vibtech, and Rosenblatt have all visited the Orange Site for orientation to SBD and the available resources.

7.4.2 National

National Shipbuilding Display Booth

The booth has been shipped to ONR facilities in Washington DC. Plans for future deployment are pending Government Program Manager direction.

Translation of Japanese CIM Project Report

This project is complete. The final report has been forwarded to the GCRMTC Executive Director for review. Copyright issues must be resolved prior to release. See the attached progress report (See Appendix Q)

Sponsorship of NSRP Projects (in process)

The project proposals were forwarded to the GCRMTC Executive Director on May 1, 1996 for review and release. The release of contracts has been delayed pending the resolution of administrative and legal issues.

The following are the NSRP Projects to be contracted:

NSRP 9-95-3	Two Interactive Multimedia Training Modules
NSRP 9-96-1	Assist U.S. Shipyards to Develop and Maintain Skilled Trades Workers
NSRP 9-96-2	Structured On-The-Job Training (combined with 9-96-1)
NSRP 4-95-1	Implementation and Update Of The Design For Production Manual
NSRP 6-95-2	Develop Leapfrog Technology to Standardize Equipment and System Installations
NSRP 8-96-3	Application of Industrial Engineering Techniques To Reduce Worker Compensation and Environmental Costs
NSRP 6-96-2	Vendor Furnished Information (VFI) Guidelines
NSRP 4-96-1	Activity Analysis for a World Class Design Model

7.5 Marketing Resources

7.5.1 Regional

Ship Repair Market Study

This project is complete and the final report has been submitted to the Executive Director for review and release. See attached progress report (Appendix R)

7.5.2 National

Marketing Resource Center Feasibility Study

The first draft of the final report has been completed. This draft is under review and revision. See attached progress report (Appendix S). This project has reviewed models for similar centers, resources available, industry characteristics, and industry needs. The result is the development of four configurations, assessment of the viability of each option, and recommendations related to creating a marketing resource center.

8. GCRMTC ACTIVITIES PLANNED FOR NEXT QUARTER

In addition to the future work described in previous paragraphs and in the individual projects in the Appendices, work is planned over the next quarter in the following areas:

1) The results from the May 1996 GIAB meeting were submitted to the GPM for review. Further recommendations concerning internal proposals and issuance of RFPs will be made by the Center.

2) Work will commence under the four subcontracts awarded in June 1996.

3) A new solicitation for internal research concept proposals will be issued in July 1996.

4) The Center received the NSRP proposals from the Orange Site on May1, 1996 (see Section 7.4.2). The Center will issue the corresponding subcontracts in August if it can satisfy the Bid Laws of the State of Louisiana. If the Bid Laws are not satisfied, the Center will reissue the RFPs in the near future.

5) The Marketing Resource Center Feasibility Study was completed and will be forwarded to the Government Program Manager for review prior to release.

6) Sixteen interim and/or final research reports will also be forwarded to the Government Program Manager for review.

7) The plans to connect the New Orleans Site to the Orange Site via a T-1 link will be completed during the next quarter.

8) Preparations will be completed for the participation in the SMM '96 Exhibition and Conference in October 1996 in Hamburg, Germany.

9) The Center will increase its efforts to provide workshops for the maritime industries.

9. SUMMARY

The GCRMTC objectives and milestones as defined by the Cooperative Agreement continue to be met in a timely fashion. The achievements of the two Sites and the Center during the second quarter of 1996 were as follows:

1) The Center has issued four subcontracts with maritime industries based on 1995 marine industry proposals. The four proposals were titled:

a. Automated Machine Learning of Diesel Engine Operating Characteristics

b. An Investigation of the Expansion of the GCRMTC Ship's Reliability, Availability, and Maintainability (RAM) Database

c. Development of a Portfolio of Ship Designs

d. Automated Off-Line Programming: A Strategic Tool to Link the Design and Manufacturing Processes

2) A master schedule for all GCRMTC activities has been included as Appendix A for reference.

3) The Center is continuing to develop the process and procedures necessary to fund the proposed NSRP projects discussed in Section 7.4.2.

4) A third solicitation for Concept Proposals was issued in January 1996 and these external and internal concept proposals were peer reviewed and considered by the GIAB in May, 1996. Recommendations were submitted to the GPM for funding of internal proposals. Recommendations will be submitted for issuance of RFPs for external concept proposals during the next quarter.

5) ERIC and SBDC are fully operational and actively addressing their respective missions.

6) The GCRMTC and its sites operated booths at the American International Shipbuilding Exposition in New Orleans in April 1996.

7) Research projects are ongoing at both sites and the status of 18 projects are appended.

10. RECOMMENDATIONS

Based on a review of the last quarter's activities of the Center, the New Orleans Site, and the Orange Site along with the feedback from the Program Manager and Staff, the following actions are recommended:

1) Upon approval from the GPM of the May 1996 GIAB Meeting recommendations, initiate internal proposals and issue appropriate RFPs for external proposals.

2) Gather the missing data for the NSRP proposals and request a fiscal decision from the Louisiana State University System regarding the award of subcontracts.

3) Continue arrangements for the Center and its two sites to attend the Shipbuilding Machinery and Marine Technology Conference in Hamburg, Germany.

4) Recognizing the uncertainty in the amount of FY96 funding, prepare contingency operational plans for the Center.

5) Plan a workshop for January 1997 to revisit the Orange Site mission.

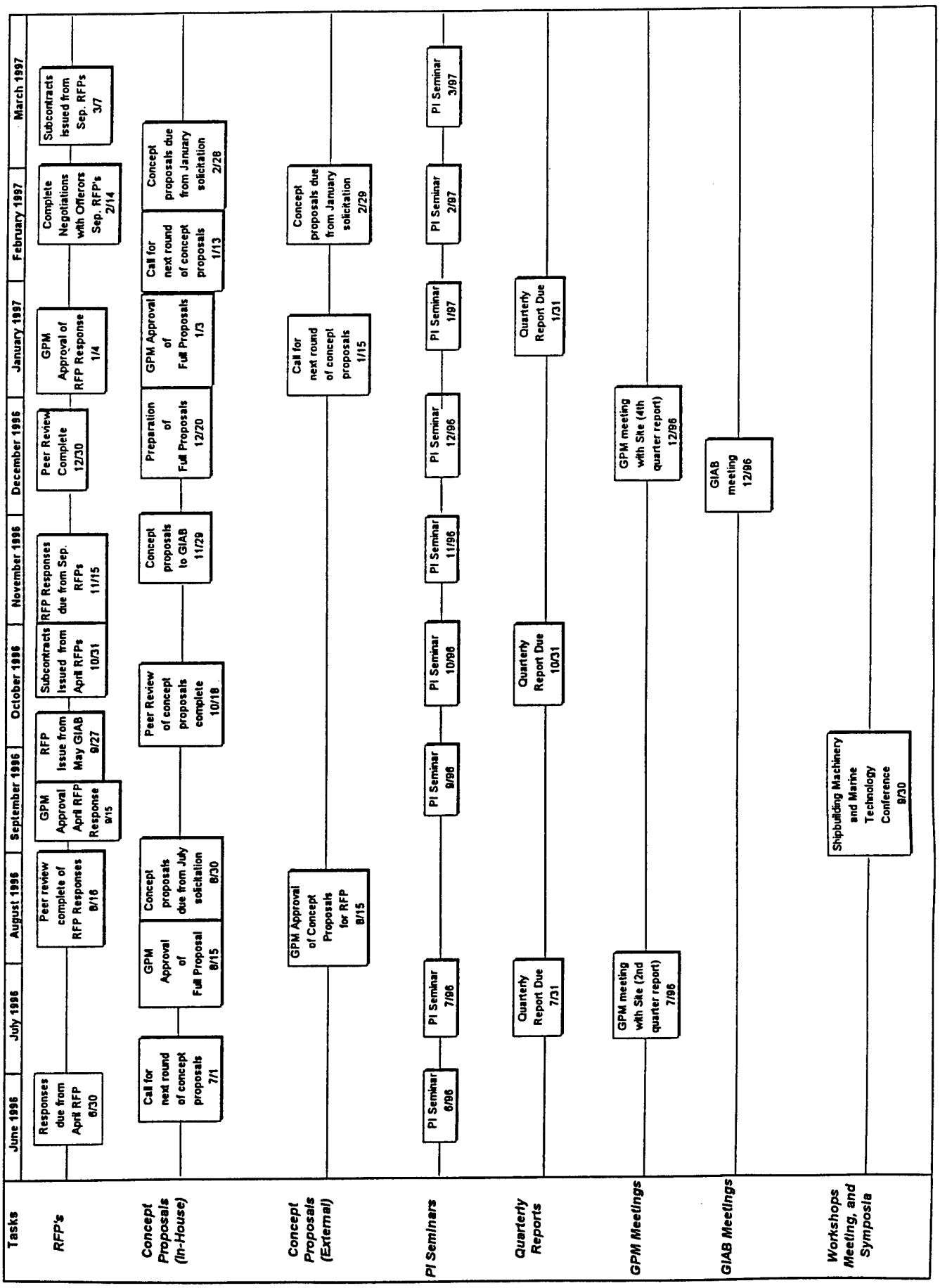
APPENDIX A

GULF COAST REGION MARITIME TECHNOLOGY CENTER

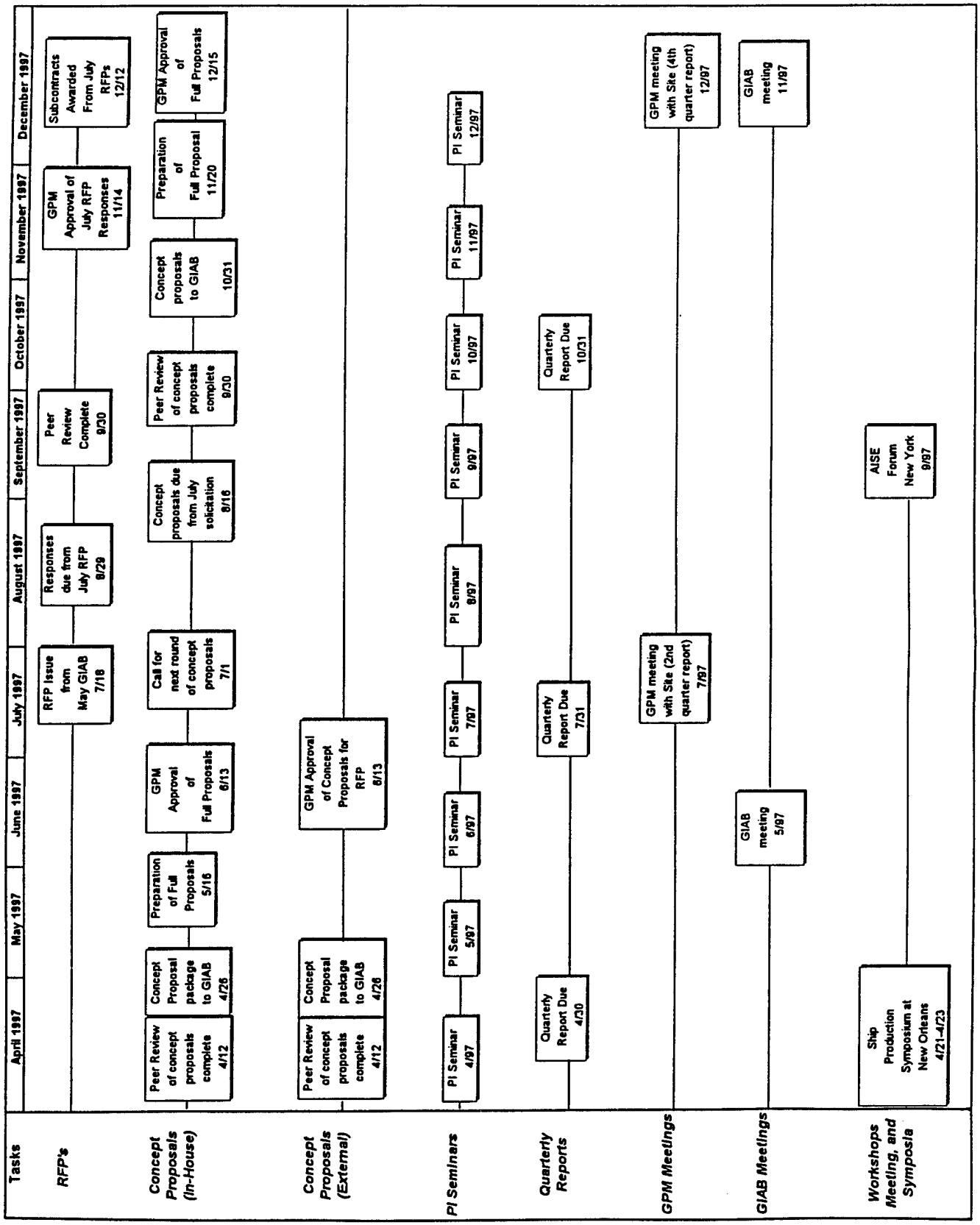
MASTER SCHEDULE

University of New Orleans
New Orleans, LA 70148

Gulf Coast Region Maritime Technology Center and New Orleans Site Master Schedule



Gulf Coast Region Maritime Technology Center and New Orleans Site Master Schedule - Cont.



GCRMTC-Lamar University Site Program Master Schedule

Name	Earliest Start	Latest Finish	Actual Start	Actual Finish	% Done
Contract Signing	⌘ 10/24/94	1/16/95	10/24/94	10/24/94	100
Core Staffing	10/24/94	5/19/95	10/24/95	❖ 2/24/95	100
Strategic Planning	10/24/94	2/24/95	10/24/95	❖ 12/2/94	100
Technology Specifications	10/24/94	8/8/95	◆ 1/15/95	2/24/95	100
Facility Design	9/12/94	8/8/95	12/5/95	⌘ 3/15/95	100
Major Software	12/5/94	1/23/95	2/27/95	⌘ 8/15/95	100
Major Equipment	12/5/94	12/12/95	2/27/95	⌘ 5/20/95	100
Facility Renovation	12/5/94	12/12/95	3/16/95	⌘ 5/20/95	100
Equipment Installation	12/5/94	9/19/95	3/16/95	⌘ 7/15/95	100
Software Procurement	12/5/94	10/31/95	2/27/95	⌘ 9/15/95	100
Equipment Grooming	1/16/95	12/12/95	7/17/95	⌘ 10/15/95	100
Software Installation	1/16/94	10/31/95	7/17/95	⌘ 10/15/95	100

Key:

⌘ Earliest start equals actual finish

◆ Early start with early finish date

⌘ Late start with early finish date

❖ On-time start with early finish date

Conclusion:

100 percent of program tasks finished on time or early.

GCRMTC-Lamar University Project Master Schedule

Name	Earliest Start	Latest Finish	Actual Start	Actual Finish	% Done
Computer Billing	® 6/14/95	3/31/96	9/1/95	3/1/96	100
Business Process	■ 6/15/95	5/31/96	7/1/95	6/30/96	92
Simulation of Outfitting	■ 10/26/95	7/31/97	10/26/96	7/31/97	0
Support of National	■ 7/15/95	7/31/97	5/1/96	12/31/97	0
Translation of Japanese	® 1/28/95	3/31/96	1/28/95	3/31/96	100
Regional Ship Repair	® 6/15/95	5/15/96	6/1/95	3/31/96	100
Marketing Resource	■ 7/1/95	8/31/96	7/1/95	6/30/96	90

Key:

■ Project proceeding on time according to revised schedule

□ Project proceeding on time according to original schedule

® Project completed

Conclusion:

Projects are proceeding according to original or revised schedule.

APPENDIX B

INEXPENSIVE NON-TOXIC PIGMENT SUBSTITUTE FOR CHROMIUM IN PRIMER FOR ALUMINUM SUBSTRATE

GCRMTC PROJECT NO. AMTC95-001A

Principal Investigator: **Alfred F. Daech**
Department of Civil and Environmental Engineering

Additional Researcher: **Kenneth L. McManis**
Department of Civil and Environmental Engineering

Additional Researcher: **Nikhil K. Sarkar**
Department of Biomaterials - LSU Medical Center

Research Assistant: **Li Li**
Department of Civil & Environmental Engineering

Research Assistant: **Raisa Moiseyeva**
Department of Biomaterials - LSU Medical Center

University of New Orleans
New Orleans, LA 70148

PROJECT SYNOPSIS: Lithium Carbonate in solution has been shown to protect certain metals, particularly aluminum, from corrosion by reacting at the surface. SIMS (Secondary Ion Mass Spectrometer) confirms this phenomena. Sodium carbonate and potassium carbonate reactions produce a soluble product and no alkali is detected on the surface by SIMS. Because of their high solubility and reactivity most "alkaline metal" compounds are not suitable for corrosion protection. Metallic aluminum normally provides its own corrosion protection due to its tendency to form an aluminum oxide insulator on the surface, but the matrix of hydrated aluminum oxide is penetrated by chemicals such as NaCl, acid and bases.

Engineers and scientists observed that certain aluminum-lithium alloys demonstrated some diffusion of lithium to the surface of the alloy. The lithium ion is so small that it penetrates the large interstitial spaces of the aluminum oxide layer. The aluminum - lithium alloys are stable in chemical composition at ordinary temperatures but a lithium-rich surface can be easily produced in the alloy by briefly heating to facilitate the migration. It appears that certain lithium alloys or compounds can be incorporated into a paint vehicle or otherwise deposited on the surface of aluminum alloys to provide corrosion protection when exposed to salt water, humidity and other corrosive environments.

The corrosion propensity of the various alloys of aluminum may be measured by electrochemical techniques. Electrochemical techniques of corrosion testing have continued to be attractive to investigators interested in corrosion. The imposition of a controlled potential via a potentiostat is a very attractive concept from a reaction kinetics point of view. Furthermore, electrical currents are simple to measure and can be directly related to electrochemical reaction rates through Faraday's Law. AC techniques can be used to determine film resistivity and thickness values. A variety of electrochemical tests have been proposed and developed. Scanning electron microscopy (SEM) and simple magnification of target metals illustrates the surface modification caused by the lithium salts. The problem is to select inhibitors, optimize them and to make them available to protect the aluminum substrates by a coating process.

The United States Navy has established an operations requirement for primers for aluminum which can be applied by personnel while on patrol. The desired product must be a fire retardant, general purpose primer which will be both protective for the exterior as well as the interior surfaces of aluminum. Material selection and usage are rigidly governed by codes; for example, those contained in proposed contaminant restrictions.

Chromium compounds provide outstanding corrosion protection of certain metals. Chromates are used in the chemical conversion coating of Aluminum, (MIL-C-5541). Chromates have reportedly been determined to be carcinogenic and therefore a replacement for them is currently being sought. Environmental Agencies limit the amount of chromium ion tolerated in waste water to less than one part per million. Thus an environmentally benign substitute is desired. Since most available corrosion inhibitors are based on heavy metals or reactive amides, the available alternates appear to fall short of the desired performance in corrosion inhibition and/or environmental suitability.

Various lithium compounds appear to offer a viable alternative to chromium using a new concept of corrosion inhibition, with a minimum of environmental impact. This research involves the creation of new primer inhibitors based on aluminum-lithium compounds and the development of a non-polluting paint vehicle which can be used as a primer.

II. BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$149,899
FUNDS REMAINING:	$109,427 as of 5/31/96

III. OBJECTIVES AND SCOPE OF RESEARCH:

(A) Objective

One objective of this project is to identify or create new primer inhibitors based on aluminum-lithium to a degree where they will represent a satisfactory substitute for the chromium paints for aluminum.

The second phase objective will be to incorporate this pigment into a paint vehicle which can be used as a primer and which is essentially non-polluting.

The final objective will be to insure that the products meet the Navy requirements for various paint specifications where possible and to arrange a manufacturing facility.

(B) Scope

The scope of this project as described is very broad. Obviously one cannot develop a new concept in coatings and follow through to a broad set of specifications and uses in one or two years for a few hundred thousand dollars. However, it will be demonstrated that the product can fulfill all of the requirements from the pigment concept to the final use. The pigment will be investigated in detail. The coating will utilize existing vehicles i.e. latexes, etc. used by the Navy under military specifications with chromate pigments. The suitability of the developed product will then be assessed to insure that it meets existing specifications.

IV. ACCOMPLISHMENTS THIS PERIOD

The fundamental piece of equipment used in this part of the program is the Model 352/252 Soft Corr™II Corrosion Measurement & Analysis Software manufactured by EG&G Instrument Division of Princeton Applied Research.

The instrument is installed and running. Qualification tests per ASTM G-3 and G-5 were run to ensure proper functioning of the equipment. A statistical series was performed after the first screening of possible pigment passivators.

Euronavy USA has provided vehicles for our formulations.

Three types of epoxy based paint vehicle.
One Styrene acrylic based latex paint vehicle.
One Acrylic/vinyl thermoplastic paint vehicle.

These vehicles are to be tested for compatibility and suitability. They are being used or considered for use by the Navy.

We are also testing a silicate which will make a paint similar to Ameron's "Dimetcoat or Carboline's "Carbozinc". These products use sodium silicate or partially hydrolyzed ethyl silicate and zinc dust. We are investigating a special silicate and an aluminum lithium dust. The zinc filled products are for steel and ours will be for aluminum.

EuroNavy USA will evaluate the coatings provided by us either as finished coatings or as pigments which they may incorporate into paints. The completion of this phase is dependent upon the installation of the argon oven and its successful operation.

The exploratory work performed during the last quarter was aimed at producing Li (Lithium) and Non-Li containing coating on aluminum and an Al (Aluminum)-alloy. Non Li - coating is intended to be used as a primer for Li-coating. If these coatings (non Li) are sufficiently corrosion resistant, they can be used as substitutes for chromate conversion coatings. The general methodology employed in producing the above mentioned coatings was as follows. The metallic coupons were immersed in the different solutions listed in Table B1. Following exposure of the coupons for a certain period of time at an elevated temperature (see Table B1), the specimens were withdrawn from respective solutions, rinsed thoroughly with distilled water and then air dried. Later, scanning electron microscopy (SEM) was used to characterize the nature of the surface of each coupon exposed to various solutions. Typical SEM micrographs illustrating the representative surface morphology of various coupons are shown in Figures B1 - B8.

TABLE B1
COATING PROCESSING VARIABLES

Material	Solution	pH	Temp.	Time
Al	Li Carbonate + Na Aluminate	11.7	60 c	15 h
AL	(1) Basic Li-Solution (2) Modified Li-Solution after Buchheit	11.7 12.8	60 c 60 c	2.5 h 15 h
AL	Zincate Solution (NaOH + ZnO)	N.D.*	37 c	15 h
AL	Na-Aluminate (NaOH + $AL(OH)_3$	N.D.*	37 c	15 h
AL	Li-Polysilicate	N.D.*	60 c	15h
AL	(1) Na-Aluminate (2) Li-Polysilicate		60 c	15m 15 m
2024-T3	Li-Carbonate + Li-Hydroxide	11.6	60 c	2.5h
2024-T3	Li-Molybdate + K-Permanganate	8.3	60 c	17h

* N.D. - Not Determined

The following figures refer to the attached photographs.

Figure B1. Shows the formation of platelet crystals on the coupon surface. Similar crystals are also seen in Figure B2; the crystals in Figure B2 are not as dense as in Figure B1. The treatments used in producing these crystals are in accordance with the modified process recommended by Buchheit (NACE 1996 Annual Conference, Paper #625). Buchheit has identified these crystals as Talc, a carbonate containing Al-Lithiate.

A dense film of black coating was observed in the zincate treated Al-coupon (Figure B3). The coating was firmly attached to the substrate but was thicker compared to the film formed on the preceding two samples. Na-Aluminate treatment led to the formation of a porous but adherent black coating on Al (Figure B4).

The coating formed by Li-polysilicate treated on Al is shown in Figure B5. It was loosely attached to the substrate and was highly non-adherent. Treatment with Li-polysicicate following Na Aluminate treatment led to the formation of a relatively more adherent film (Figure B6). The coating, however, cracked on drying.

The coating formed an alloy 2024-T. Following Buchheit's original treatment (Buchheit etal., Corrosion, 50, 205, 1994) is shown in Figure 7. The surface morphology is similar to that seen in Figure B6, but is distinctly different from that obtained by Buchheit's modified treatment. (Figures B1 and B2). The coating formed on alloy 2024-T3 treated with Li-Molybdate and K-permanganate was characterized by a duplex structure and was extremely non-adherent.

Discussion of Results:

The statistical series has provided a series of passivator combinations. Promising new compounds have been ordered for continuing passivator studies.

The previous passivators selected from the series have been tested at various pH values. The breakdown potentials are being checked.

A scanning electron microscope has been donated by LSU for our surface studies. It will be set up this quarter. Meanwhile we are using the SEM at LSU Dental School. Preliminary results show the coatings deposited on aluminum. We will continue to improve film quality.

We now have two aluminum-lithium samples on hand, "Alcoa 2090" and "COMALCO's" new alloy. We have found two sources for the aluminum-lithium powders "Homogeneous Alloys" at $5/# and "Valley Metals."

EuroNavy USA has sent resinous vehicles for test batches of primer. We are also considering two new resins which have unique properties.

The delay in delivery of the Argon Oven caused a gap in our schedule of 2 ½ months as we cannot treat the pigment until it is installed. We expect the oven to arrive mid-July.

A first look at alloys 1100, 2219, 5052 and 6061 indicates that they are all passivated by the system. This is important since other metals are alloyed with the aluminum.

Significant developments resulted from the first year investigations. First, several inhibitors in the form of lithium salts seem to show promise especially Lithium Nitrate. Since all carbon dioxide was flushed out of the water and the water certified ultra pure water with no carbonate, the formation of "Talcite" coating described in U.S. Patent 5,266,356 does not seem probable with these inhibitors. It appears more likely that Lithium Alumnate (inert ceramic) or some other reactant or structure is being deposited. Investigations will continue into 1996. The patent write-up is under preparation but, additional data is needed to round out this application.

The second innovation is called "Nanostructural Inhibitors." The ratio of atoms on the surface to the body of a typical tiny pigment particle is about 1:10,000. If we heat Aluminum Lithium to 300 C, the Lithium migrates to the surface. This is done under Argon and although the Lithium is only 2 or 3% by weight, the surface collects about 90% Lithium. This should improve the corrosion resistance of the alloy and provide surface sites for reacting citrate, etc. This has been documented.

Typical structures painted 20 or more years ago with chrome or lead pigments retain their color if cut, indicating that surface inhibitors may be effective and that much of the inhibitor is not consumed, and not necessary.

Thirdly, since heating in Argon, tends to drive the Lithium to the surface of the Aluminum-Lithium alloy, properties such as fracture toughness, and weldability should be improved. This will be a separate investigation. The light weight of the Aluminum Lithium alloy is desirable but the fracture properties and welding present problems. The relocation of lithium to the surface should enhance corrosion resistance, improve fracture properties and simplify welding. A third patent is being considered.

The fourth thrust is a statistical study of the inhibitors. It seems that there are advantages in blending inhibitors. These salts are particularly adaptable to statistical analyses since they are compatible with one another. Greco Latin Squares are presently being used. Taguchi methods may be used later.

Dr. Nikhil Sarkar has been used as a consultant as planned in the first year. He has twenty-five years experience in electro-chemistry work and is enthusiastic about the results. He is being assisted by Dr. Raisa Moiseyeva, a metallurgical engineer. Their effort will be the deposition of a continuous passivating protective film from the film formers and passivators we are finding on a microscopic scale. Later when the best film is determined we will perform coatings on a macroscopic scale.

V. PROPOSED ACTIVITIES NEXT PERIOD

(1) **Continuing Pigments**
Interactions of pigments and vehicles are being investigated. Organo-lithium compounds are being tested.

(2) **Argon Oven**
An Argon Oven will be used to generate Lithium-rich surfaces. The lithium particles will be converted to pigments.

(3) Further experimentation is planned with various Li- and non-Li salts (those are tested now for corrosion resistance evaluation), singly or in combination, to produce adherent coatings on pure Al and selected Al-alloys.

(4) Microstructural (SEM) analysis of the cross-section of these coatings is planned to characterize their morphology and to determine the nature of their adherence to respective substrates.

(5) Chemical analysis of various coatings will be carried out by energy dispersive x-ray analysis (EDXA).

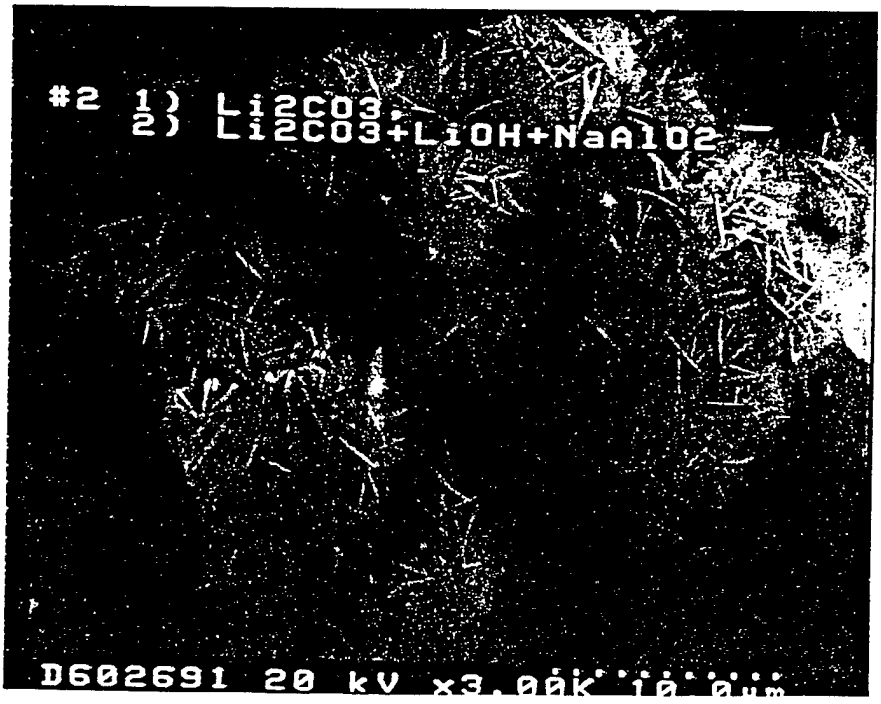
(6) Electrochemical corrosion testing of selected coated aluminum alloys will be carried out.

(7) Formulate simple paints and coat panels will be formulated. Corrosion resistance will be assessed.

COLLABORATIVE EFFORTS:	THIS QTR.	YTD.
$ VALUES OF SERVICES FROM INDUSTRY:		$ 5,000
IN KIND SERVICES (EXPERIMENTAL VEHICLES)		$ 5,000
ACTUAL FUNDS:		NONE
EURO NAVY TESTING OF PIGMENTS THIS YEAR:	$15,000.	$15,000
$ VALUE OF EQUIPMENT FROM LSU	$10,000	$10,000
$ VALUES OF SERVICES FROM GOVERNMENT:		$150,858
IN KIND SERVICES:	NONE	NONE
ACTUAL FUNDS:		$150,858
# OF SIGNIFICANT CONTACTS:		
INDUSTRY	3	11
ACADEMIC	1	6
GOVERNMENT	1	5


#1 NaAlO2+Li2CO3
D602689 20 kV x10.0k 3.00µm

(1)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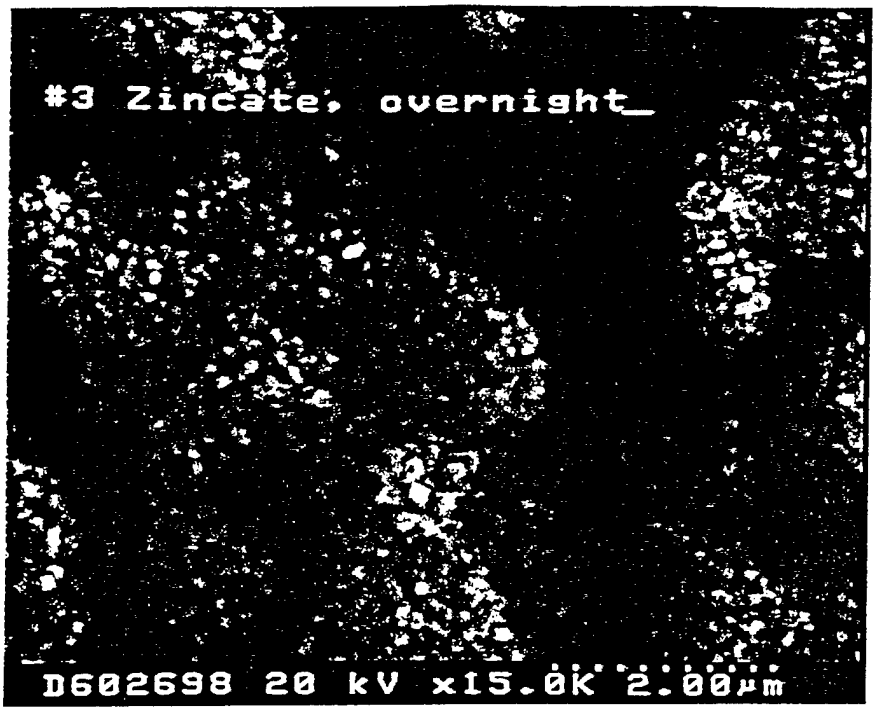
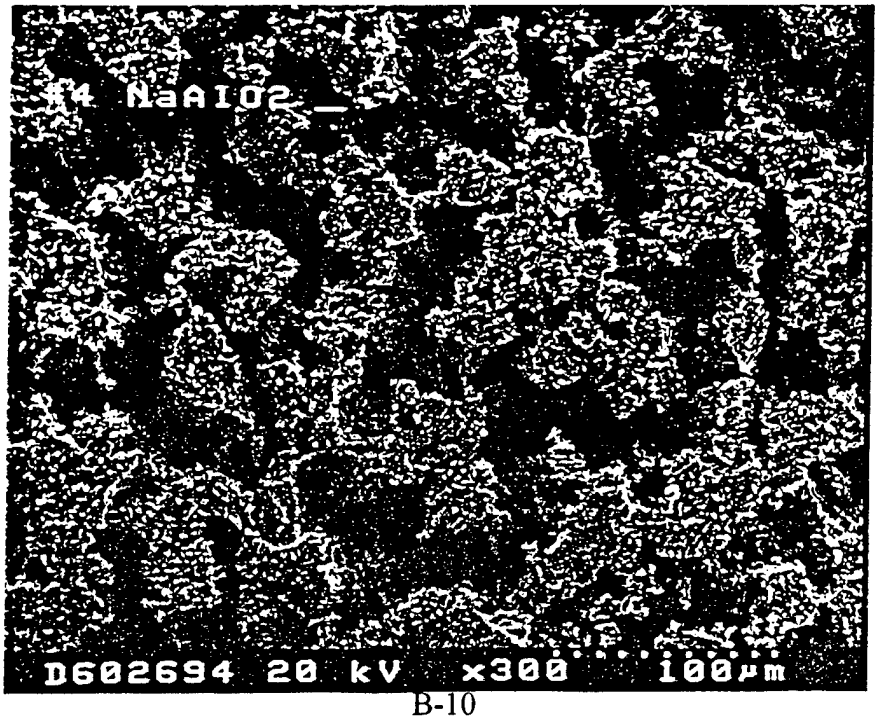
2) Li2CO3+LiOH+NaAlO2
D602691 20 kV x3.00k 10.0µm

(2)


#3 Zincate, overnight_
D602698 20 kV x15.0K 2.00µm

(3)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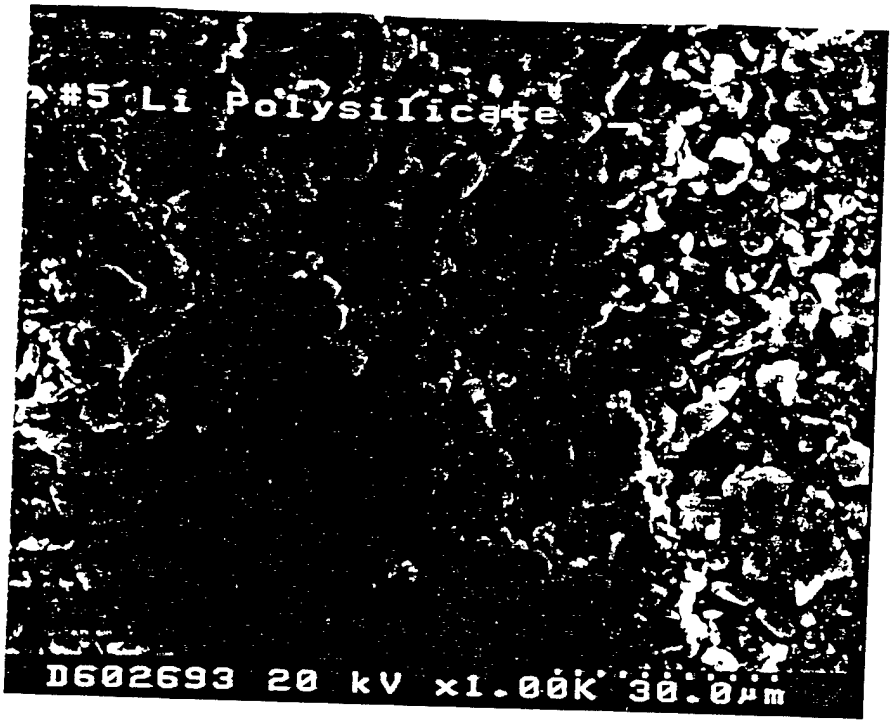
D602694 20 kV x300 100µm

(4)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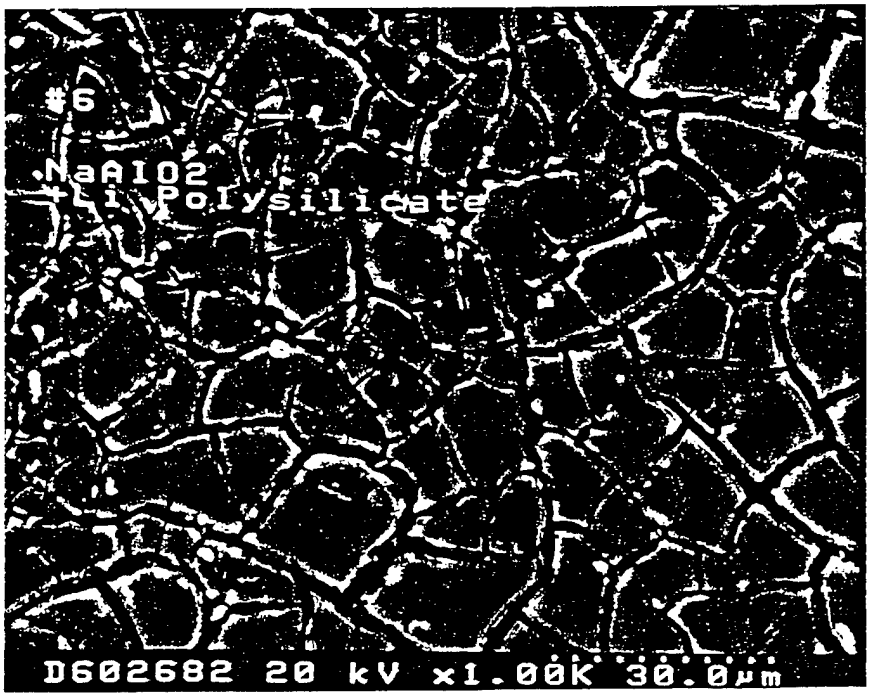
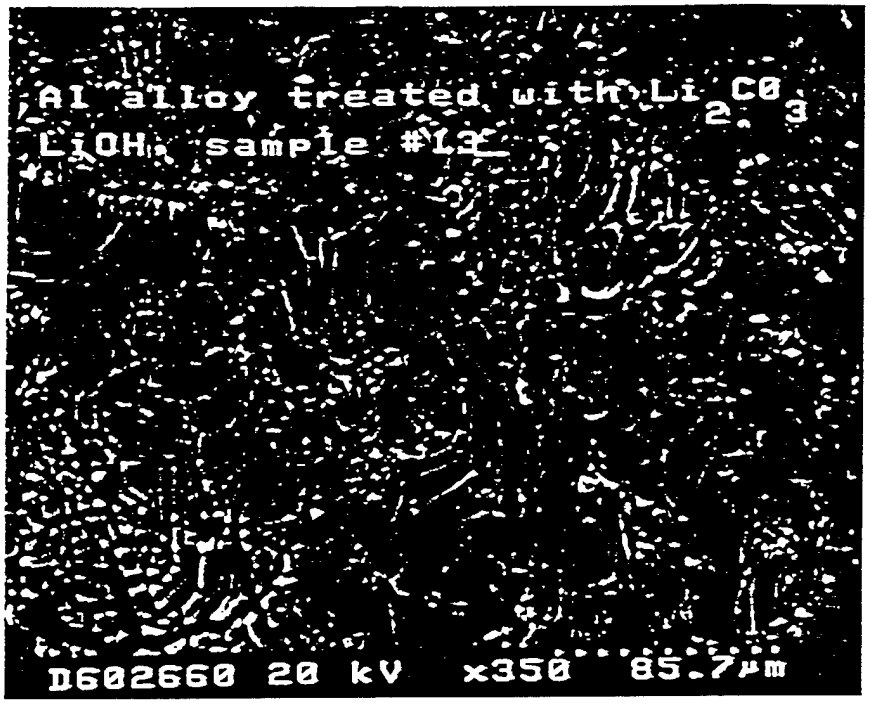
D602693 20 kV x1.00K 30.0µm

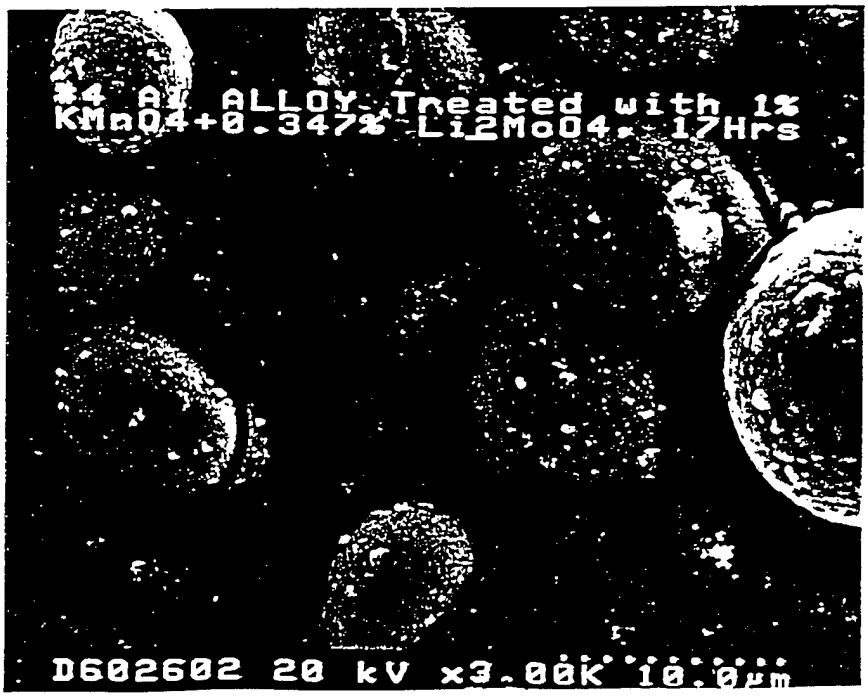
(5)


#6
NaAlO2
+Li Polysilicate
D602682 20 kV x1.00K 30.0µm

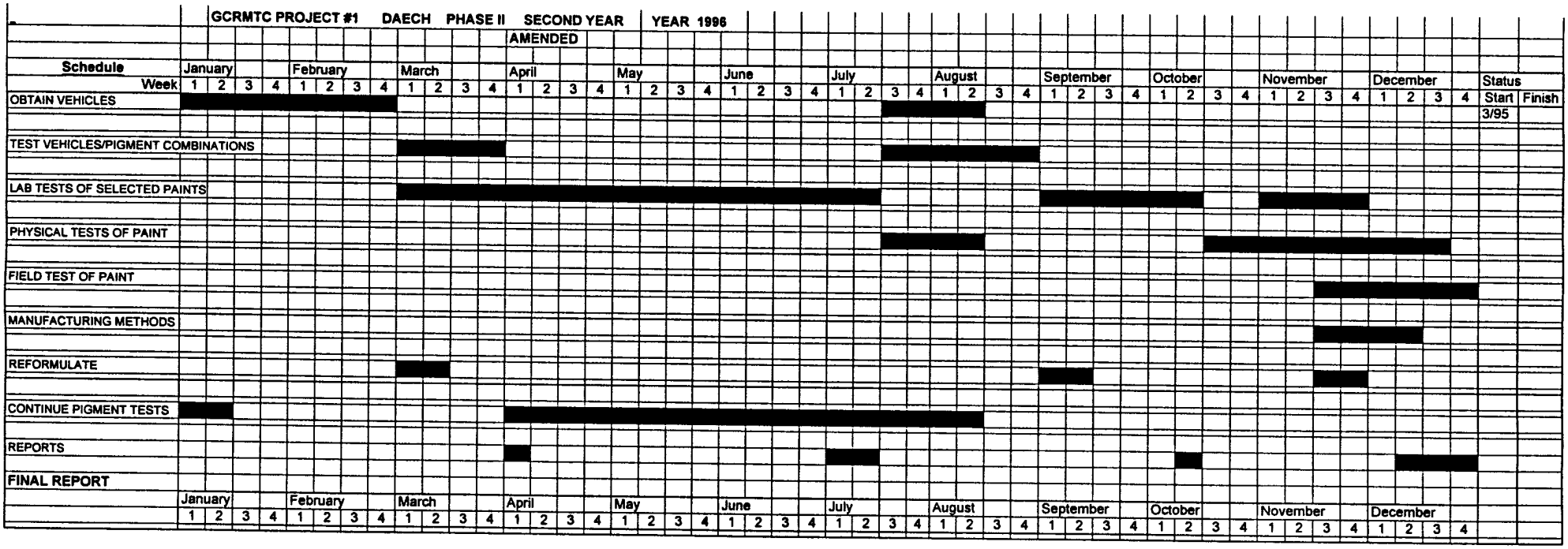
(6)


Al alloy treated with Li2CO3
LiOH, sample #13
D602660 20 kV x350 85.7µm

(7)


#4 Al ALLOY Treated with 1%
KMnO4+0.347% Li2MoO4. 17Hrs
D602602 20 kV x3.00K 10.0µm

(8)


GCRMTC PROJECT #1 DAECH PHASE II SECOND YEAR YEAR 1996
AMENDED
Schedule
Week
January
February
March
April
May
June
July
August
September
October
November
December
Status
Start
Finish
3/95
OBTAIN VEHICLES
TEST VEHICLES/PIGMENT COMBINATIONS
LAB TESTS OF SELECTED PAINTS
PHYSICAL TESTS OF PAINT
FIELD TEST OF PAINT
MANUFACTURING METHODS
REFORMULATE
CONTINUE PIGMENT TESTS
REPORTS
FINAL REPORT

APPENDIX C

INTEGRATED ENVIRONMENTAL MANAGEMENT PLAN FOR SHIPBUILDING FACILITIES

GCRMTC PROJECT NO. AMTC95-008A

Principal Investigator: **Bhaskar Kura**
Department of Civil & Environmental Engineering

Additional Investigator: **Enrique La Motta**
Department of Civil & Environmental Engineering

University of New Orleans
New Orleans, LA 70148

PROJECT SYNOPSIS: This project is aimed at developing an integrated environmental management plan for shipbuilding facilities that includes source reduction (waste minimization at the source), recycling, treatment and disposal. To achieve the research objectives, Avondale Shipyard will be closely studied with data collection from other sources on activities that are not common to Avondale. The project duration is three years with interim reports at the end of each year. The final product will contain two reports, a specific Environmental Management Plan (EMP) report to serve Avondale and a generic EMP report to serve the shipbuilding industry in general.

The main components of the study are process review, identification of sources of pollution, quantification of pollutants (in solid, water, and air streams), impact evaluation, review recycling/ treatment alternatives, study disposal alternatives, and regulatory compliance. The first year activities include a study of sources of pollution, emission quantification and some progress on characterization of waste streams and a review of current pollution management practices.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED	$ 159,380
FUNDS REMAINING	$ 425

NOTE: This project received its funding approval in the beginning of June 1995, rather than the usual start date of January. Major accomplishments year to date and during the quarter, April - June 1996 are presented below:

ACCOMPLISHMENTS YEAR TO DATE:

According to the proposal, the following five tasks were to be completed (some in full and some in partial) in the first year which ended on May 31, 1996. A discussion on these tasks and the work completed is presented below:

Task 1: Literature Review

Accomplishments during April-June 96

- This task was completed in December 1995. New NSRP project reports and EPA publications were reviewed.

Prior Accomplishments

- Available information from EPA sources, NSRP SP-1, University of Michigan was collected and reviewed. Other published and non published information from various sources was reviewed. The collected information related to shipyard processes, waste emissions, currently practiced environmental management procedures, and pollution control options.

Task 2: Identification of Waste Streams through Field Visits

Accomplishments during April-June 96

- This activity was completed in December 1995.

Prior Accomplishments

- Several field visits were made to Avondale Shipyard to identify the sources of waste generation and the waste streams. Field surveys provided information on sources of wastewater, air emissions, and solid/hazardous wastes.

- Individual shop surveys were initiated after a questionnaire was sent to various shops at Avondale Shipyard. Individual shops contacted included paint shops, blast houses, machine shops, pipe shops, insulation departments and others.

- National Shipbuilding and Steel Company (NASSCO) was visited in October 1995 to obtain generic information on waste streams.

Task 3: Quantification of Wastes (Solid, Liquid, and Air Emissions)

Accomplishments during April-June 96

- This task was completed in May 1996. During this quarter, additional information pertaining to Avondale was compiled.

Prior Accomplishments

- Documents required for quantification of wastes from EPA and NSRP-SP1 sources were identified and obtained for the project use.

- Quantification methods available from AP-42 documents and other EPA methods were reviewed. Quantification methods for emissions of volatile organic compounds (VOCs) and particulate in air streams were completed.

Task 4: Characterization of Waste Streams

Accomplishments during January - March 1996

- This activity was scheduled for completion by the 18th month from the beginning of the project. First year activities under this task included characterization of air streams only. Two important categories of air pollutants in shipyards are particulates (total particulates and particulates less than 10 micron (PM10)) and VOCs most of which are hazardous air pollutants (HAPs).

- Discussions were held with Dr. Matthew Tarr, Chemistry Department, UNO and Dr. Isiah M. Warner, Chemistry Department, LSU regarding VOC monitoring for ambient air quality. Instead of measuring ambient VOCs using Portable Gas Chromatograph (GC), a total VOC analyzer will be used to investigate the high concentration areas. Disadvantages of using a portable GC are, (1) longer analysis time and (2) non-applicability to continuous samples. A total VOC analyzer manufactured by Thermo Environmental Inc. was purchased recently.

- During this quarter, a significant amount of time was spent in ambient air quality monitoring for particulates and VOCs.

- Figure C1 shows a typical output of ambient PM10 concentrations observed during blasting operations. The ambient air quality monitoring carried out so far has been an exploratory type to investigate the potentially high concentration points.

Prior Accomplishments

- Available information was reviewed for the project. For field investigations, a particulate analyzer capable of measuring ambient particulates and particulate emissions from various sources was selected for purchase.

- Particulate monitoring equipment, DATARAM and MINIRAM were received in January 1996. Both of these instruments will measure particulate concentration based on light scattering principle. DATARAM measures total particulate matter (TPM), PM10, and PM2.5. MINIRAM measures the total particulate concentration or the exposure level.

- Ambient air quality at Avondale Shipyard was measured on several days at several strategic locations using the above equipment. Ambient air quality was determined for an averaging time of one hour for both TPM and PM10.

Task 4A: Feasibility - Air & Water Quality Monitors

Accomplishments during April-June 1996

- This activity was just initiated in June 1996. Drs. Yang, Li, and Lee are working on this activity in the GCRMTC research project titled, "Applications of Integrated Optical Fiber Sensor Systems in Shipbuilding and Shipboard Monitoring."

Prior Accomplishments

- None. This task was newly added and will be performed during the second year, June 1996 to May 1997.

Task 5: Review of Existing Waste Management Techniques

Accomplishments during April-June 1996

- Three visits were made to Avondale to collect information on waste management practices for wastewater, solid/hazardous wastes and air emissions. This activity was originally planned to be completed by the 18th month from the beginning of the project.

- Additional information from other shipyards is being collected.

Prior Accomplishments

- Field visits were conducted at Avondale Shipyard to understand the wastewater treatment plant, waste collection methods, waste shipments off-site for disposal, and types of air pollution control equipment.

Other Accomplishments during April-June 96

A paper was submitted earlier to the Air & Waste Management Association (A&WMA) entitled, "Typical Waste Streams in a Shipbuilding Facility." This paper was presented at A&WMA's 89th annual proceedings. The conference was held in Nashville, Tennessee, June 1996.

PROPOSED ACTIVITIES NEXT PERIOD:

1. Continue ambient air quality monitoring for particulates and VOCs.
2. Initiate wastewater analysis and possibly the receiving water body analysis.
3. Continue to work on current waste management practices.
4. Initiate work on waste minimization task for the shipbuilding industry.
5. Coordinate feasibility investigation of a portable water quality analyzer with Drs. Lee and Yang.
6. Coordinate feasibility investigation of a portable air quality analyzer with Drs. Li and Yang.

COLLABORATIVE EFFORTS	THIS QTR	YTD
$ VALUES OF SERVICES FROM INDUSTRY:		
IN KIND SERVICES:	7,500[a]	45,900
ACTUAL FUNDS:		
$ VALUES OF SERVICES FROM GOVERNMENT:		
IN KIND SERVICES:	14,300[b]	14,300
ACTUAL FUNDS:		
No. OF SIGNIFICANT CONTACTS:		
INDUSTRY:	0	25
ACADEMIC:	2[c]	4
GOVERNMENT:	0	6

COMMENTS:

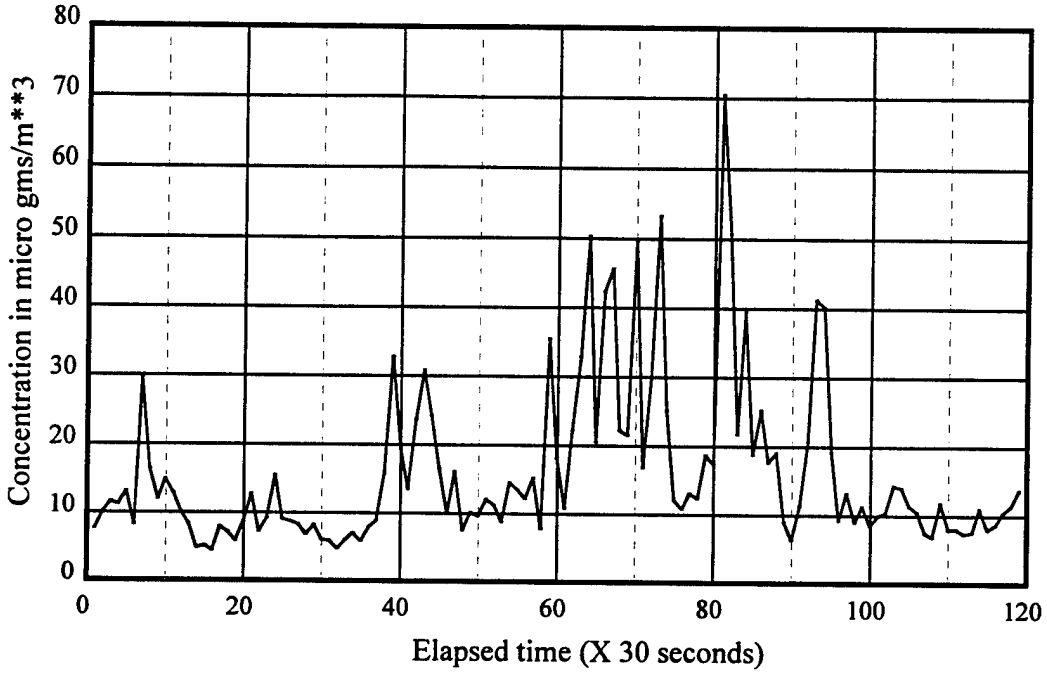
a) Includes the cost of Avondale staff time during field visits, providing information, assisting during field measurements etc. A total of $7,500 accounted toward half man-month time of Avondale personnel.

b) Dr. Isiah Warner of Louisiana State University and Dr. Matthew Tarr of University of New Orleans have spent their time on the project. The estimated value of their time is $ 6,300. The estimated value of the time spent by the personnel of Environmental Protection Agency (EPA) and the Louisiana Department of Environmental Quality (LDEQ) is $ 8,000.

c) Significant contacts made this quarter in academic category are:

1. Dr. Matthew Tarr, Assistant Professor
   Department of Chemistry
   University of New Orleans
   New Orleans, Louisiana

2. Dr. Isiah M. Warner, Chair and West Professor
   Department of Chemistry
   Louisiana State University
   Baton Rouge, Louisiana



PM_{10} concentrations in $\mu g/m^3$ *

- Average: 16.1
- Maximum: 96.5
- Minimum: 4.1

Meteorological information

Temperature: 56^0-79^0 F Relative humidity: 50% Wind direction: SSE

Relevant information

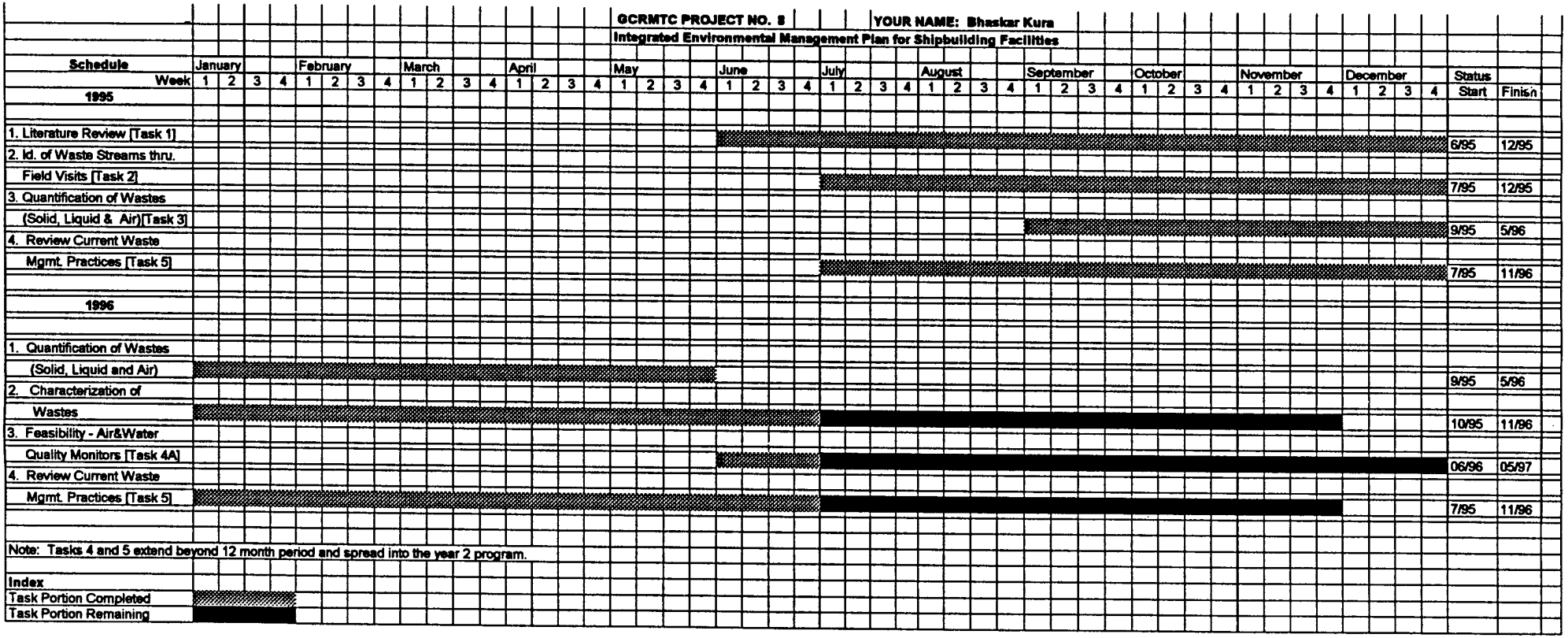
Paint blast house was in operation during the observation period.

** Averaging time: 10 seconds; Logging period: 30 seconds.*
Average value corresponds to the average of '30 second averages'. Maximum and minimum values are based on '10 second averaging time' observations.

Figure 1. Temporal variation of ambient PM_{10} concentration. (SP-01; 02; 03/14/96)

GCRMTC PROJECT NO. 8 **YOUR NAME: Bhaskar Kura**

Integrated Environmental Management Plan for Shipbuilding Facilities



APPENDIX D

UNO-SWIFTSHIPS DEVELOPMENT OF A COST EFFECTIVE ALUMINUM CATAMARAN STRUCTURE

GCRMTC PROJECT No. AMTC95-010A

Principal Investigator: **Robert Latorre**
Naval Architecture and Marine Engineering

Additional Researcher: **Paul Herrington**
Department of Mechanical Engineering

Additional Researcher: **Michael Folse**
Department of Civil and Environmental Engineering

Additional Researcher: **Marcio Vasconcellos**
Naval Architecture and Marine Engineering

University of New Orleans
New Orleans, LA 70148

PROJECT SYNOPSIS: Currently, US shipbuilders are not competitive in the worldwide high-speed passenger ferry market, while shipbuilders in many foreign countries have advanced the design of high speed catamarans to the point that they are marketing these craft worldwide. This project addresses the problem of developing a high speed catamaran design for the US and worldwide passenger ferry market. It is focused on improving the productivity of US shipyards by addressing the integration of catamaran design and manufacture through the research and development of an aluminum structural extrusion that will reduce the number of components, the welding required, and result in a lightweight high performance vessel.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$186,517
FUNDS REMAINING:	$ 98,859

ACCOMPLISHMENTS THIS PERIOD:

A structural test system was developed which included:

- Installation of software upgrade for structural test system.
- Establishing a plan for safe operation of the test system.
- Performance tests with various structural components to investigate system response, and calibrate force-response of test pieces.

Task I – Market overview using CATSSD database and shipyard input determined the following market niche data based on the database results and shipyard input:

- Length	40 m
- Beam	11 m
- Draft	1 m
- Displacement	160 - 200 tons
- Speed	40 - 45 kts
- Market niche	High speed crew boat

Task II – Preliminary design of hull structure based on design-rule specified hull loads.

- Verified design loads.
- Modified finite element model of welded aluminum plate/stiffener.

- Modification of hull structure design in progress.
- Meetings have been held with Engineering Cybernetics to discuss nonlinear aspects of the plate/stiffener response and with industrial collaborator concerning modeling of the welded and extruded plate.
- Conducted tow tank model tests. (Resistance and seakeeping tests.)

Task III – Development of rational catamaran plate structure using standardized aluminum extrusion(s) to minimize ship production costs:

- Participated in the ANSYS seminar at Engineering Cybernetics
- Literature search undertaken for a) deformation of plate/stiffener from welding and b) relative costs of welding versus extrusion.
- Obtained current Ship Structure Committee Guidelines for finite element analysis of ship structures and components.
- Obtained the Aluminum Association's requirements for designing aluminum structures.
- Contacted a major aluminum extruding company concerning extrusion details.

Task IV – A final design for production will be undertaken.

- Task to be undertaken once Tasks II and III are complete.

Task V – Travel to shipyards/technical conferences to present results.

- Participated in the Offshore Technology Conference in Houston, 5/9/96.

PROPOSED ACTIVITIES NEXT PERIOD:

Task I – Market overview using CATSSD data base and shipyard input:

- Continue discussions with shipyard partner concerning market opportunities.

Task II – Preliminary design of hull structure based on design-rule specified hull loads.

- Continue optimization studies on fixed versus floating frame structure.

Task III– Development of catamaran structure design using standardized aluminum extrusion(s) to minimize ship production costs.

- Finite element modeling comparing welded plate versus extruded plating.
- Local optimization of extruding.
- Manufacture of extrusion.

Task V – Travel to shipyards/technical conferences to present results

- Update meetings with shipyards are planned.

COLLABORATIVE EFFORTS:	**This Qtr.**	**YTD**
DOLLAR VALUES OF SERVICES FROM INDUSTRY:		
IN KIND SERVICES:	$42,000	$49,000
ACTUAL FUNDS:		
DOLLAR VALUES OF SERVICES FROM GOVERNMENT:		
IN KIND SERVICES:	–	–
ACTUAL FUNDS:		
NUMBER OF SIGNIFICANT CONTACTS:		
INDUSTRY:	10	13
ACADEMIC:	–	–
GOVERNMENT:	–	–

COMMENTS:

DOLLAR VALUES OF SERVICES FROM INDUSTRY:

Swiftships, Inc., has agreed to materially participate in this project by contributing the following:

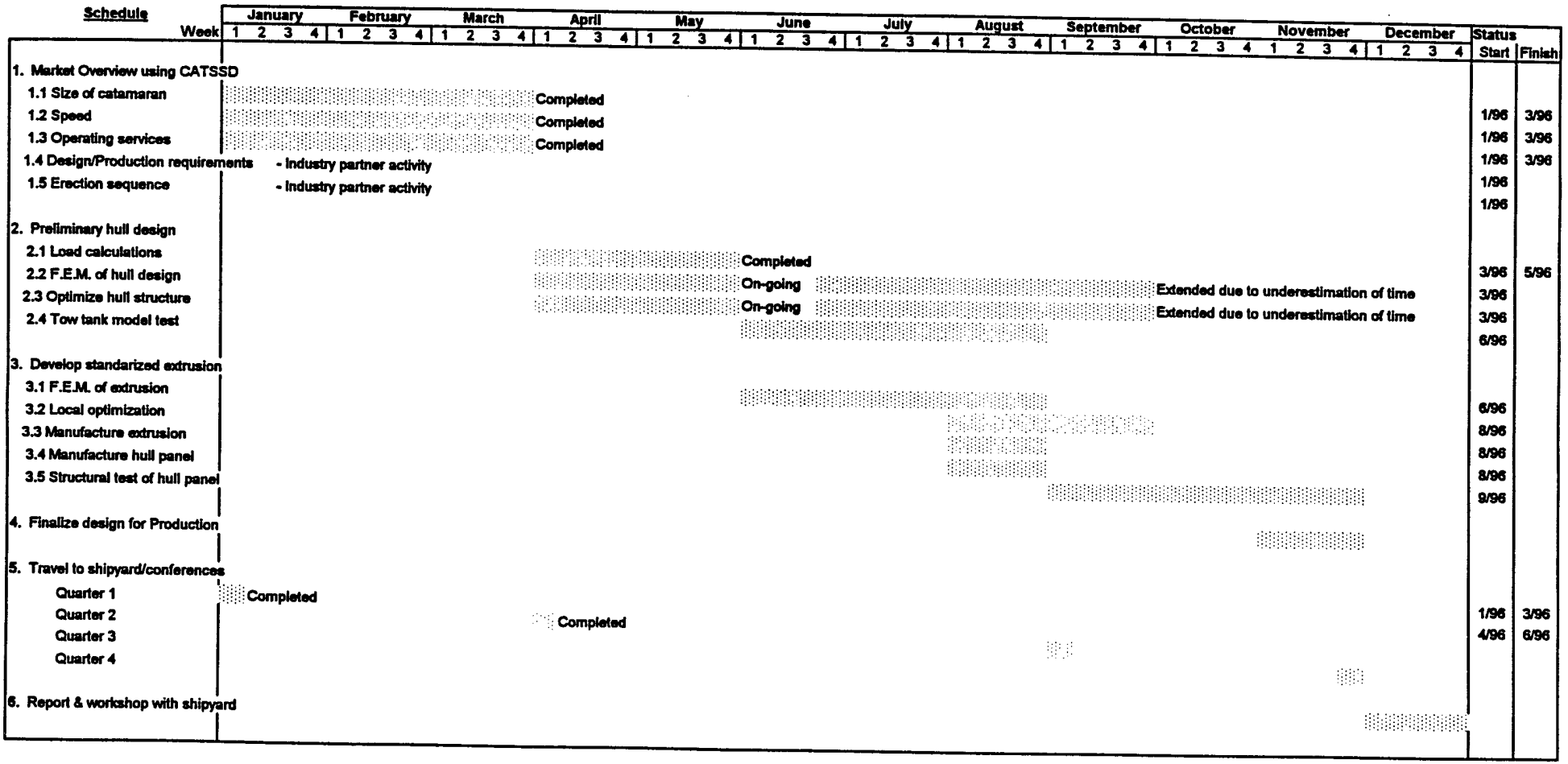
- Participate in the catamaran structure design/analysis. (Estimated cost = $5,000)
- Participate in the aluminum floating frame design. (Estimated cost = $2,000)
- Obtain materials and manufacture of floating frame, expected delivery next quarter. (Estimated cost of materials and labor = $40,000)

NUMBER OF SIGNIFICANT CONTACTS:

A number of industry contacts were made as a result of participation in the Offshore Technology Conference. Some of the contacts made include Ray Pennell of Lloyd's Register, J. John of ABS, Philippe Rucho of Bureau Veritas, and Richard Cole of MMFG.

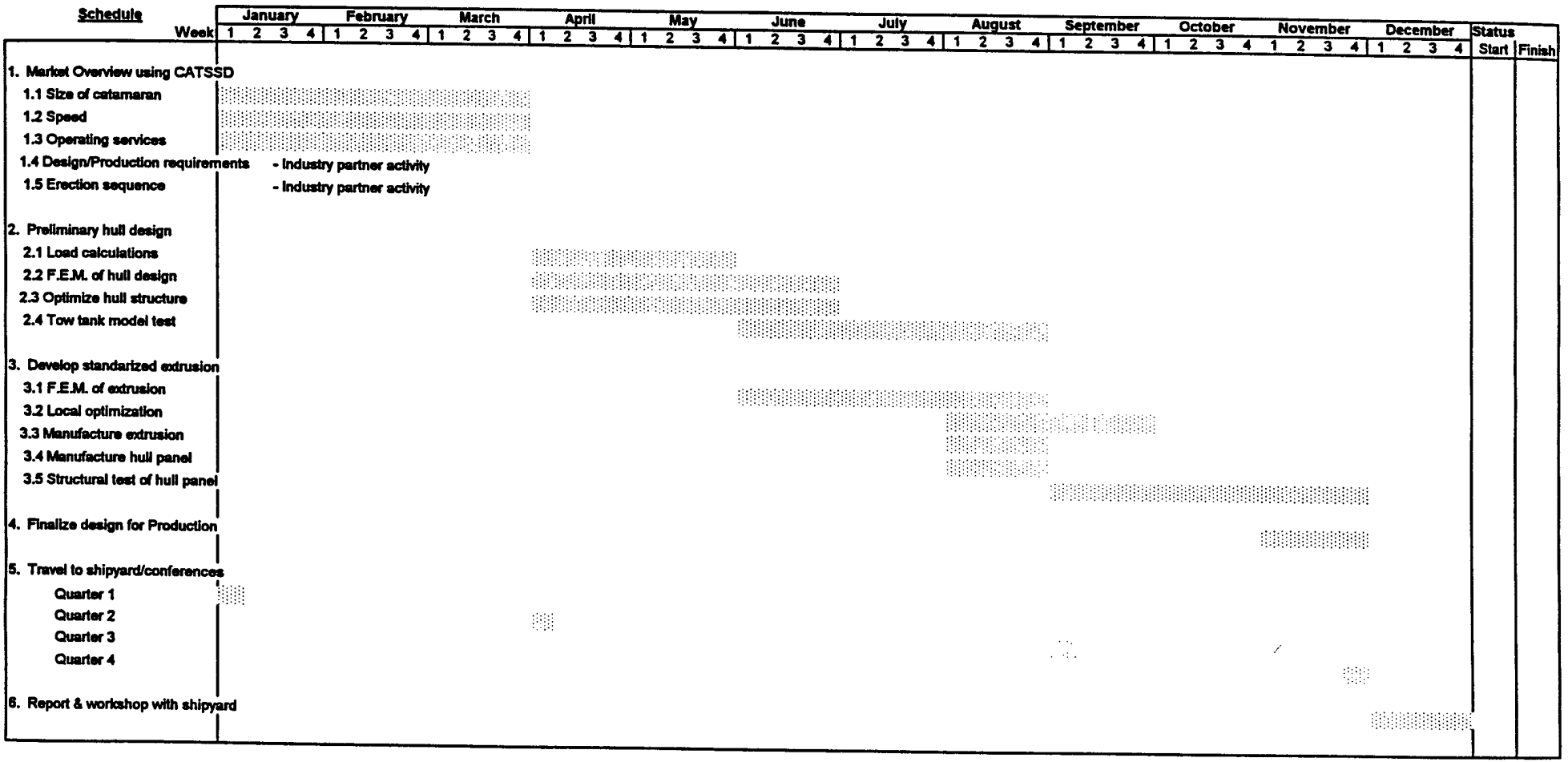
UNO-Swiftships Development of A Cost Effective Aluminum Catamaran Structure Incorporating Extrusions

Current Status - Second Quarter (6/96)



UNO-Swiftships Development of A Cost Effective Aluminum Catamaran Structure Incorporating Extrusions

Proposed Timeline



APPENDIX E

APPLICATIONS OF INTEGRATED OPTICAL FIBER SENSOR SYSTEMS IN SHIPBUILDING AND SHIPBOARD MONITORING

GCRMTC PROJECT NO. ATMC95-014A

Principal Investigator: **Shing Lee**

Department of Electrical Engineering

University of New Orleans

New Orleans, LA 70148

PROJECT SYNOPSIS: Fiber-optic-sensor systems are compact, sensitive, and can be multiplexed throughout a ship to provide hazard warning, pollution and processing monitoring. This project is to investigate the applicability of shipboard monitoring using such systems. A novel fiber-optic-sensor system based on in-line photopolarimetric measurements was developed during the first year of the project. The performance and cost issues have been addressed. The second phase of this project is to improve the existing sensors and to address the issues of sensor multiplexing in a large scale. In particular, fiber-Bragg-grating systems will be investigated.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$85,135
FUNDS REMAINING:	$57,427

ACCOMPLISHMENTS THIS PERIOD:

(i) The improved in-line fiber-optic photopolarimeter has been assembled and demonstrated within one percent deviation. It is now in a rugged package awaiting the inspection by the LSU Technology Transfer Office as a patent application procedure. The device is ready for field testing.

(ii) The parts for the Er-doped fiber laser and amplifier have arrived. An Er-doped fiber amplifier has been assembled and tested. Fiber-Bragg-gratings have been provided by the Naval Research Laboratory for a preliminary study of our tunable fiber grating laser. A phase mask for fabricating fiber-Bragg-gratings has been purchased; and in-house fabrication of fiber-Bragg-gratings is underway.

(iii) An evanescent fiber-sensor using etched D-shape fiber is being mounted on an insulator and a glass substrate to gauge pollution in a harsh high voltage environment. This is part of a collaborative effort with Entergy Corp. to develop pollution monitors. All levels of salt contamination level have been measured within the sensor linear range.

PROPOSED ACTIVITIES NEXT PERIOD:

(iv) Continue to build the tunable fiber-optic Er-doped laser and test its feasibility in interrogating a large-scale fiber-Bragg-grating sensor network.

(v) Fabricate fiber-Bragg-gratings of variable periods using a phase mask and an excimer laser on loan from Dr. O'Conner of the UNO Chemistry Department.

(vi) Fabricate fiber-grating temperature and pressure sensors by mounting fiber-Bragg-gratings on different substrates.

(vii) Collaborate with NRL to develop novel fiber-Bragg-grating modulation and demodulation systems.

(viii) Collaborate with Dr. Trahan in Project AMTC95-016A and continue to work on the interface and package of the sensor systems for field testing.

COLLABORATIVE EFFORTS:

$ VALUES OF SERVICES FROM INDUSTRY TO DATE:	**THIS QTR**	**YTD**
IN-KIND SERVICES:		
None		
ACTUAL FUNDS:		
A collaborative effort with Entergy in developing evanescent pollution sensors	$60,500	$60,500
$VALUES OF SERVICES FROM GOVERNMENT:		
IN KIND SERVICES:		
Fiber-Bragg-gratings	$10,000	$10,000
ACTUAL FUNDS:		
None		

 # OF SIGNIFICANT CONTACTS:

INDUSTRY:

3M, Lasiris, Electro TEK, Innovative Fiber, Newport

ACADEMIC:

Dr. Russell Trahan, Department of Electrical Engineering, UNO

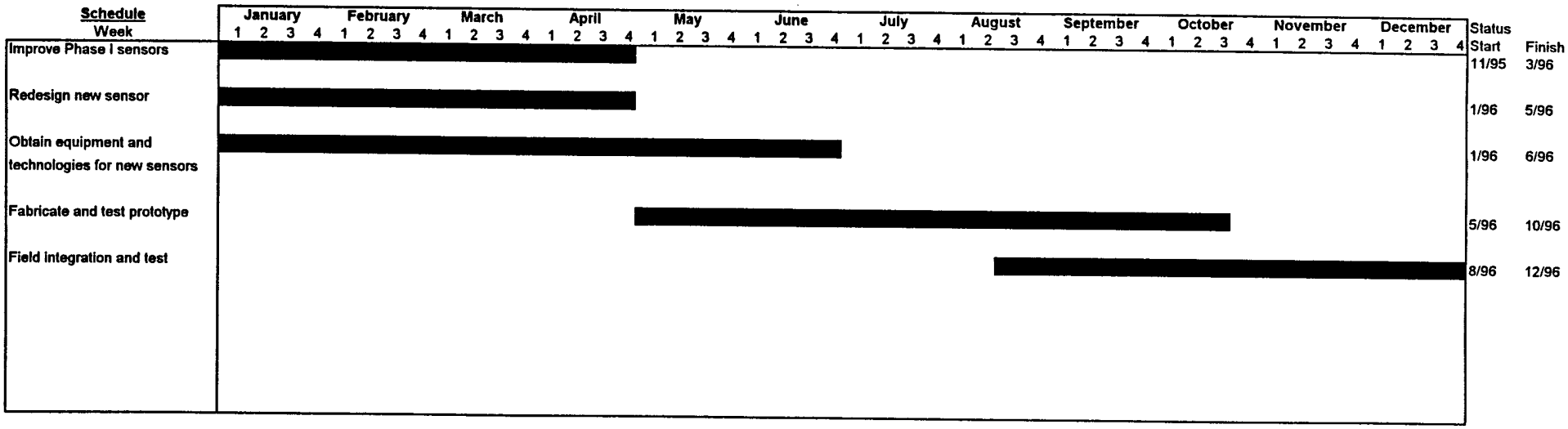
GOVERNMENT:

Dr. Allen Kersey, Naval Research Lab.

COMMENTS:

Dr. Lee is currently doing research in the Naval Research Laboratories (NRL), working with Dr. Kersey. A number of our tentative plans in fiber-Bragg-grating interrogation techniques are being tested. The results are very encouraging. We are currently developing collaborative efforts for the immediate future.

Applications of Integrated Optical Fiber Sensor Systems in Shipbuilding and Shipboard Monitoring (Phase II)



APPENDIX F

RESEARCH IN SHIPBOARD SENSORS

GCRMTC PROJECT NO. AMTC95-016A

PRINCIPAL INVESTIGATOR: **Dr. Russell E. Trahan, Jr.**
Department of Electrical Engineering

University Of New Orleans
New Orleans, LA 70148

PROJECT SYNOPSIS: This project is a continuation of "Project AMTC95-016A - Shipboard Sensors," begun in 1995. The main thrust of this project is to develop multi-mode fiber optics based environmental sensors for shipboard use.

The tasks to be completed in the second phase of this project are

Task 1: Comparison Testing.
Task 2: Repackaging.
Task 3: Identify Vessels for Testing.
Task 4: Install Prototype System
Task 5: Prototype System Evaluation,
Task 6: Progress and Final Reports.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$228,476
FUNDS REMAINING:	$105,421

ACCOMPLISHMENTS THIS PERIOD:

Activities associated with Task 1 of Phase II and completion of Phase I:

Quotes have been received from both SOTEC (commercial) and Securiplex (military) for state-of-the-art electrical temperature, flame, and smoke damage control sensors. Procurement is awaiting refined prices and improved delivery schedules from the two vendors.

Gems flooding switches, which are used in both commercial and military shipboard applications, have been procured and are currently under laboratory comparison evaluation.

Efforts have started to design the software interface for the fiber optic flame sensor and establish a test plan for the flame sensor performance evaluation.

The sensor processing algorithms for the smoke and flooding devices have been completed and evaluated with actual fiber optic sensors.

We have received the fiber optic temperature sensor assembly and prepared a preliminary test plan.

Testing of the new temperature sensor has been initiated in the environmental chamber at one optical wavelength for complete performance characterization. Evaluation at a second wavelength is awaiting delivery of a replacement laser diode. Efforts are underway to identify a suitable semiconductor laser replacement at the appropriate wavelength.

Activities associated with Task 2:

Completed the design and assembly of the fiber optic flooding sensor's prototype package. Smoke sensor package design has been completed and final assembly is awaiting the delivery of a screen mesh cover.

Activities associated with Task 3:

Discussion is underway with Ingalls Shipbuilding regarding the installation of the current fiber optic prototype sensor suite within a compartment aboard a Navy ship this year.

Dialogue has begun with a "Smartship" proposal team regarding the possibility of placing an upgraded fiber optic damage control system aboard this ship for evaluation next year.

Activities associated with Task 4:

During the next quarter, after a ship is identified on which the sensors may be used, the system will be installed and testing will be initiated.

PROPOSED ACTIVITIES NEXT PERIOD:

Activities associated with Task 1:

Completion of fiber optic temperature sensor evaluation and system interface.

Receipt of military and commercial electrical flame, smoke, and temperature sensors for comparison testing.

Completion of electrical sensor characterizations and comparison tests.

Activities associated with Task 2:

Design housing for temperature sensor to meet shipboard standards.

Activities associated with Task 3:

Continue discussions with Ingalls about upgrades to packaging required for ship installation and testing.

Continue "Smartship" dialogue.

COLLABORATIVE EFFORTS:	THIS QTR	YTD
$ VALUES OF SERVICES FROM INDUSTRY:		
IN KIND SERVICES:	$28,042	$28,042
ACTUAL FUNDS:		0
$ VALUES OF SERVICES FROM GOVERNMENT:		
IN KIND SERVICES:		0
ACTUAL FUNDS:		0

NUMBER OF SIGNIFICANT CONTACTS:

INDUSTRY: Bill Duke, Litton Data Systems
Ray Johnston/Stan Owen, Ingalls Shipbuilding
Dr. Will Warren/Robert Miller, Ingalls Shipbuilding
Mark Ippolito, SOTEC

ACADEMIC: Dr. Shing Lee, Department of Electrical Engineering, UNO

GOVERNMENT: Carl Jacobsen, NAVSEA

COMMENTS:

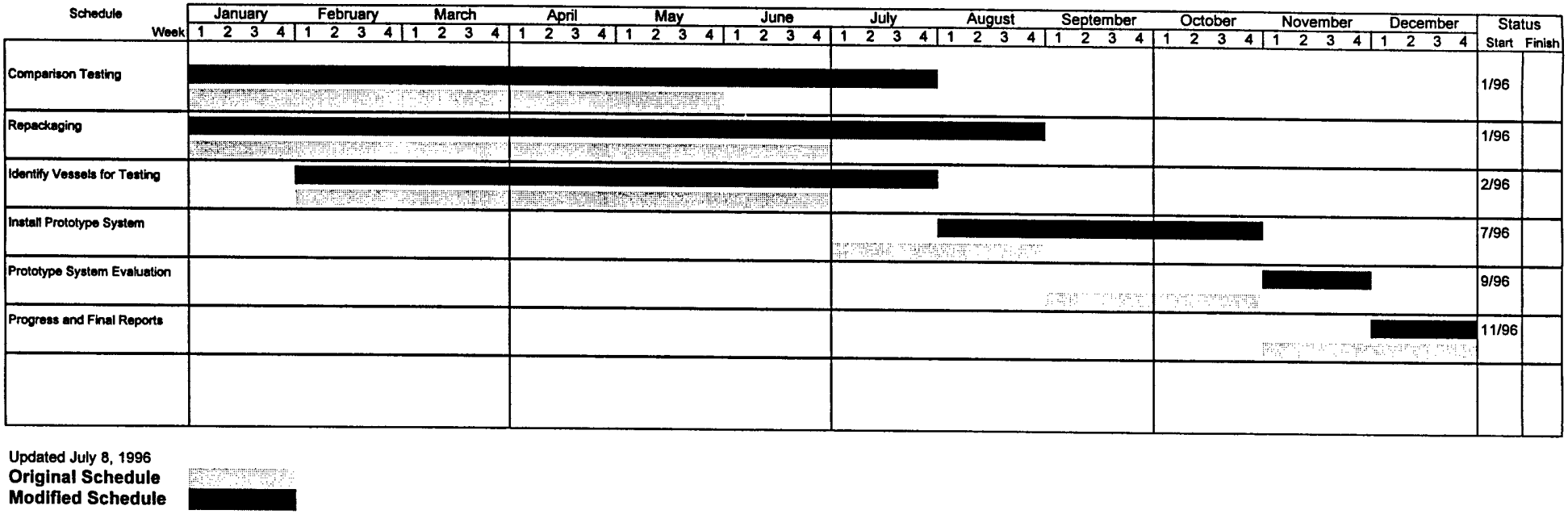
The attached time line represents the best estimate of the schedule to complete the tasks associated with this project. The task, Comparison Testing has been extended from the end of May to the end of July since we have had problems identifying the vendors of the commercial sensors. During the last quarter we made a very solid contact with SOTEC, a local vendor of both commercial and military sensors. The representative of SOTEC, Mr. Mark Ippolito, is very enthusiastic about providing us with technical, cost, and delivery information. We will be ordering these sensors very soon.

The repackaging effort has been pushed from the end of June to the end of August. This delay is largely due to the delay in obtaining the temperature sensor prototype from our fabricator. Due to the initial funding delays at the beginning of this year, our subcontractor, Design Tech, was unable to begin fabrication until the second quarter. The device was recently delivered and is undergoing testing. A housing for the actual sensor head will be designed soon.

The task to identify vessels for testing is progressing but we have pushed the time-to-complete to the end of July. Our contacts at Ingalls are working to secure a place on a US Navy ship for installation of the system and we anticipate a response by the end of July. As soon as a ship is identified, we will be placing the system on board with completion by the end of October. This will leave the month of November to complete the prototype system evaluation.

The month of December will be used for the writing of the Final Report.

Shipboard Sensors (Phase II)



Updated July 8, 1996

Original Schedule

Modified Schedule

APPENDIX G

RELIABILITY, AVAILABILITY, AND MAINTAINABILITY (RAM) DATABASE / SHIPNET OF SHIP OPERATIONS COOPERATIVE PROGRAM (SOCP)

GCRMTC PROJECT NO. AMTC95-018A

Principal Investigator: **Bahadir Inozu**
School of Naval Architecture and Marine Engineering

Additional Researcher: **Philippe Roy**
School of Naval Architecture and Marine Engineering

Additional Researcher: **Veronique Molinari**
School of Naval Architecture and Marine Engineering

Additional Researcher: **Juan Manero**
School of Naval Architecture and Marine Engineering

Additional Researcher: **Iskender Gursoy**
School of Naval Architecture and Marine Engineering

Additional Researcher: **Ivan Radovic**
School of Naval Architecture and Marine Engineering

Additional Researcher: **Linxiong Li**
Mathematics Department

Additional Researcher: **Nejat Karabakal**

University of New Orleans
New Orleans, LA 70148

PROJECT SYNOPSIS: Set up & populate the integrated RAM Database of Ship Operations Cooperative Program (SOCP) and establish & activate the data exchange network SHIPNET. The overall objective of this project is to provide marine industry with robust equipment performance data to improve total life cycle of ships in terms of safety, reliability, cost-effectiveness and overall quality. SHIPNET is a computer based system of RAM data collection, evaluation and dissemination. This consists of a network of integrated RAM databases connected to the master database located at GCRMTC. SHIPNET has been formed to facilitate the efficient collection, analysis, and sharing of vessel life cycle data and to promote consensus building activities in the maritime industry.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$406,000
FUNDS REMAINING:	$302,639

ACCOMPLISHMENTS THIS PERIOD:

TASK I - DATE & SHIPPER Development / Test and Modifications

Testing of DATE and SHIPPER Version 2.0 is completed. An implementation workshop was held at UNO on May 13-14 for chief engineers of project participants. Definitions of some data entry fields have been finalized and final DATE and SHIPPER upgrades have been identified before full scale testing and implementation. In addition to various minor modifications, the main modifications are the following:

- Addition of a "data collection start date and time" field in the equipment nameplate
- Addition of a marker to identify critical equipment
- Modifications of the corrective maintenance sub-window. The general design will be improved by implementing a "folder type" display.
- Additional items for the tabular time line display: the tabular time line display will include two new options: "equipment class detailed report" and "single equipment detailed report."
- Modifications of the Mean Time Between Failures (MTBF) and Failure Rate (FR) reports: MTBF will be displayed in both running and calendar hours. FR will be displayed in failures per 10,000 running hours and in failures per 10,000 calendar hours.

TASK II - SPIN and SHIPS' RAM Development

SPIN/SHIPS' RAM prototype (v. 1.0) has been finished and is currently under full scale beta testing at GCRMTC. This prototype was demonstrated at the SOCP executive committee meeting on May 16, 1996. Source codes of SPIN and SHIPS' RAM (Versions 1.0 Beta) are identical. However, SPIN runs with personal Oracle on a PC whereas SHIPS' RAM runs with Oracle 7 in a workstation environment with more data manipulation functions.

Task III - DATE Interfaces

ARCO Marine, Inc. reviewed and approved the specifications of the DATE interface with ARCO's VRS and MMS Fleetworks. However, the modifications of DATE will require a few adjustments in the specifications of the interface programs. DCC's effort currently focuses on modifying DATE and SHIPPER. Code development of the interface programs will follow the completion of DATE modifications.

The Reliability, Operation and Maintenance division developed a data transfer program in order to download ETG's voyage files in ASCII text format into the Watcom SQL database format used by DATE. The prototype of this program was successfully tested and the voyage history of ETG's LNG Virgo for the 1990-1996 period was transferred into the DATE program.

USCG's MSTEP-RAM database/SHIPNET Interface plan was approved and signed on April 11, 1996.

Task IV. Population of RAM Database

ETG's expanded equipment nameplate data has been transferred into the equipment database of DATE program for the pilot ship LNG Virgo. In addition, voyage information of the LNG Virgo has been entered in the DATE program.

ARCO provided the complete failure history of the main boiler feed pumps installed on board ARCO's entire fleet for the 1986-1996 period. Mr. Matthew MacDonald of ARCO identified matching DATE fields for these data. This pump failure data was transferred into the RAM database.

Task V. Analysis of RAM Data

Preliminary pilot studies have been continued to demonstrate the immediate use of SOCP's RAM database. The case study for the main condensate pumps has been continued with the involvement of two manufacturers. The use of RAM techniques have been demonstrated as a management decision support and various cases were investigated at the demand of the ship operators. Requested performance indicators include mean time to failure, reliability, average down time per year and projected cost with and without rate of interest and inflation rate.

The study for ARCO's main boiler feed pumps has been continued. The complete failure history of 22 pumps installed on board 10 ships has been analyzed. The reliability functions have been derived for each ship. A comparison between the performance of two different types of seals has been started.

Task VI. Creation of SHIPNET Help Desk

Creation of a position to operate the SHIPNET Help Desk has been requested from UNO. SHIPNET help desk is not expected to be fully operational before the last quarter of this year, which will probably correspond to the beginning of the full scale testing of the various SHIPNET programs.

Various definitions have been finalized for DATE and SHIPPER guidelines during the implementation workshop. These definitions are being reviewed by the SOCP members. A DATE and SHIPPER user's guide is being developed.

Task VII. SEM Training / Strategic Planning / Build One Requirements Definitions

A subcontract has been signed between the University of New Orleans and Rockwell International for the SEM training, strategic planning and Build One requirements definitions. Mr. Charles V. Amaral of Rockwell International attended the implementation workshop held at UNO on May 13-14, 1996. The initial survey for the implementation of these tasks has been started. A joint three day SEM training / Strategic Planning meeting will be held on August 19-21, 1996 at Sea-Land headquarters in Charlotte, North Carolina.

Task VIII. International Ship Network Development - Phase IV

Contacts with various shipping organizations and classification societies have been continued mainly in Norway. The paper entitled " SOCP's RAM Database / SHIPNET: A Cross Functional Network for Ship Life Cycle Cost and Safety Decision Support," was presented at ICMES'96: Safe and Efficient Operation of Ships - New Approaches for Design, Operation and Maintenance, held on June 13-14, 1996 in Trondheim, Norway. The authors of this paper are Bahadir Inozu, Zbigniew J. Karaszewski, and Peter G. Schaedel.

PROPOSED ACTIVITIES NEXT PERIOD:

1. Implement DATE & SHIPPER modifications
2. Continue the testing of SPIN and Ships' RAM beta version
3. Modify the specifications of the DATE interface programs according to the new version of DATE and SHIPPER
4. Finalize DATE and SHIPPER user's guide and guidelines

5. Continue the pilot study for ARCO's main boiler feed pumps

6. Create SHIPNET help desk

7. Organize SEM Training and Strategic Planning

COLLABORATIVE EFFORTS:	THIS QTR	YTD
$ VALUES OF SERVICES FROM INDUSTRY:		
IN KIND SERVICES:		
SOCP/ Energy Transportation Group	$21,600.00	$30,100.00
SOCP/Sea-Land Service Inc.	$ 1,000.00	$ 7,000.00
SOCP/ARCO Marine Inc.	$13,500.00	$15,750.00

ACTUAL FUNDS:

SOCP (Cont.): $ 58,000.00

$ VALUES OF SERVICES FROM GOVERNMENT:

IN KIND SERVICES:

ACTUAL FUNDS: Same as above*. SOCP is an industry-government cooperative program.

 # OF SIGNIFICANT CONTACTS: 28

INDUSTRY: P.G. Schaedel and Don McLendon (Energy Transportation Group), M. Bohlman (Sea-Land), F. Lee and Matthew MacDonald (ARCO Marine), F. Bankert and R. Nagendran (PRC), R. Conachey, A.K. Seah and E. Reilly (ABS), G. Jones and Dr. Z. Bazari (Lloyd's Register), Egil Rensvik and Roar Henningsen (MARINTEK), Terje Sten and Helge Audun Sandtorv (SINTEF), Jon Rysst, Tor Erik Andersen, Rolf Skjong, and Terje Staalstrom (DNV).

ACADEMIC: Prof. Magnus Rasmussen (NTNU)

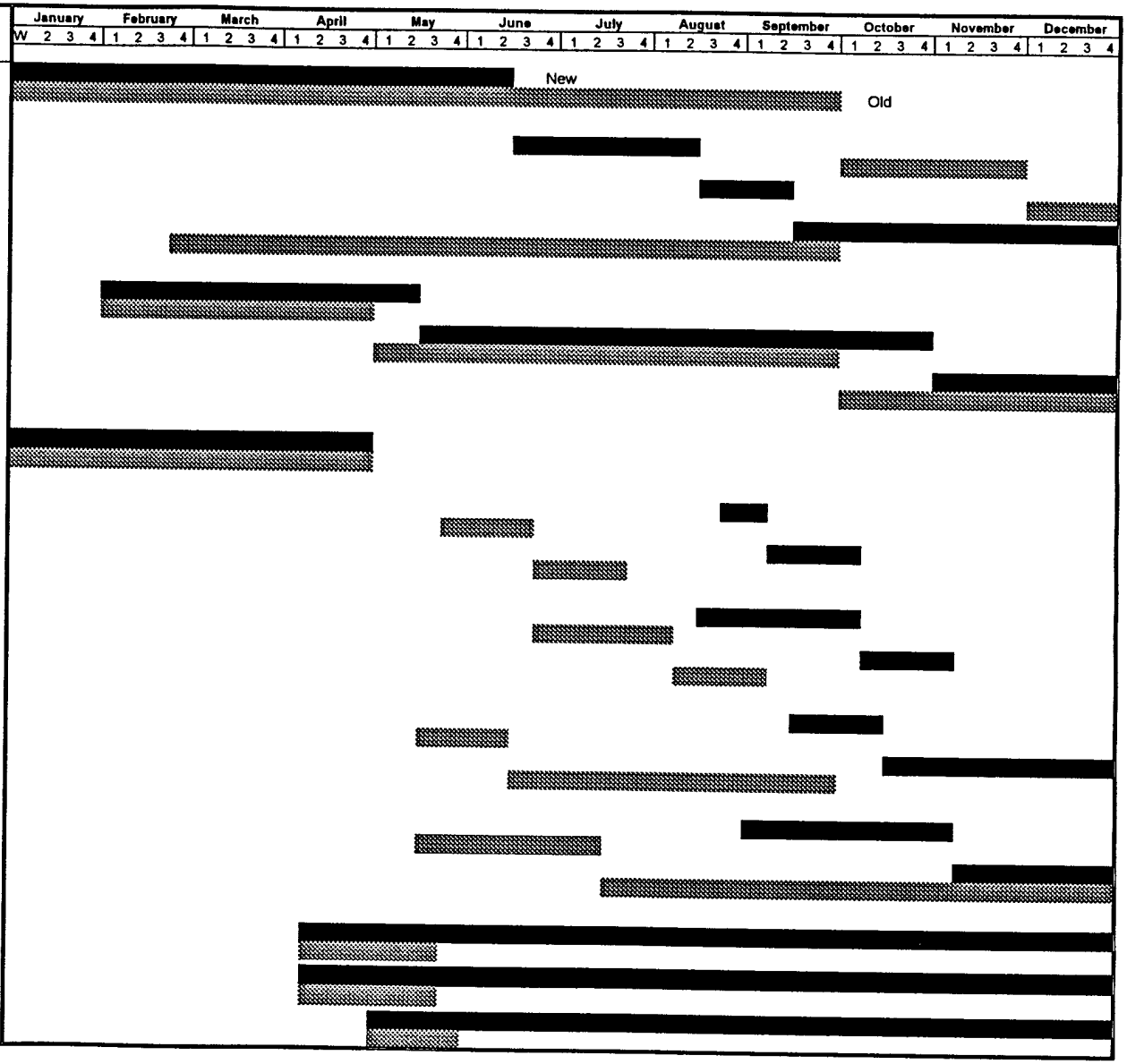
GOVERNMENT: J. Zok, P. Randall and M. Delpercio, Jr. (MARAD), G. Miante, Z. J. Karaszewski, N. Lemley (USCG - National Maritime Center).

SCHEDULE MODIFICATIONS:

Code development of interface modules has been rescheduled to accommodate the new DATE structure. DATE and SHIPPER modifications are ahead of the schedule since SOCP decided to implement the modifications without further on board testing. Schedule for the customization of DATE has been extended since some participants are updating their files and waiting for the completion of interface modules.

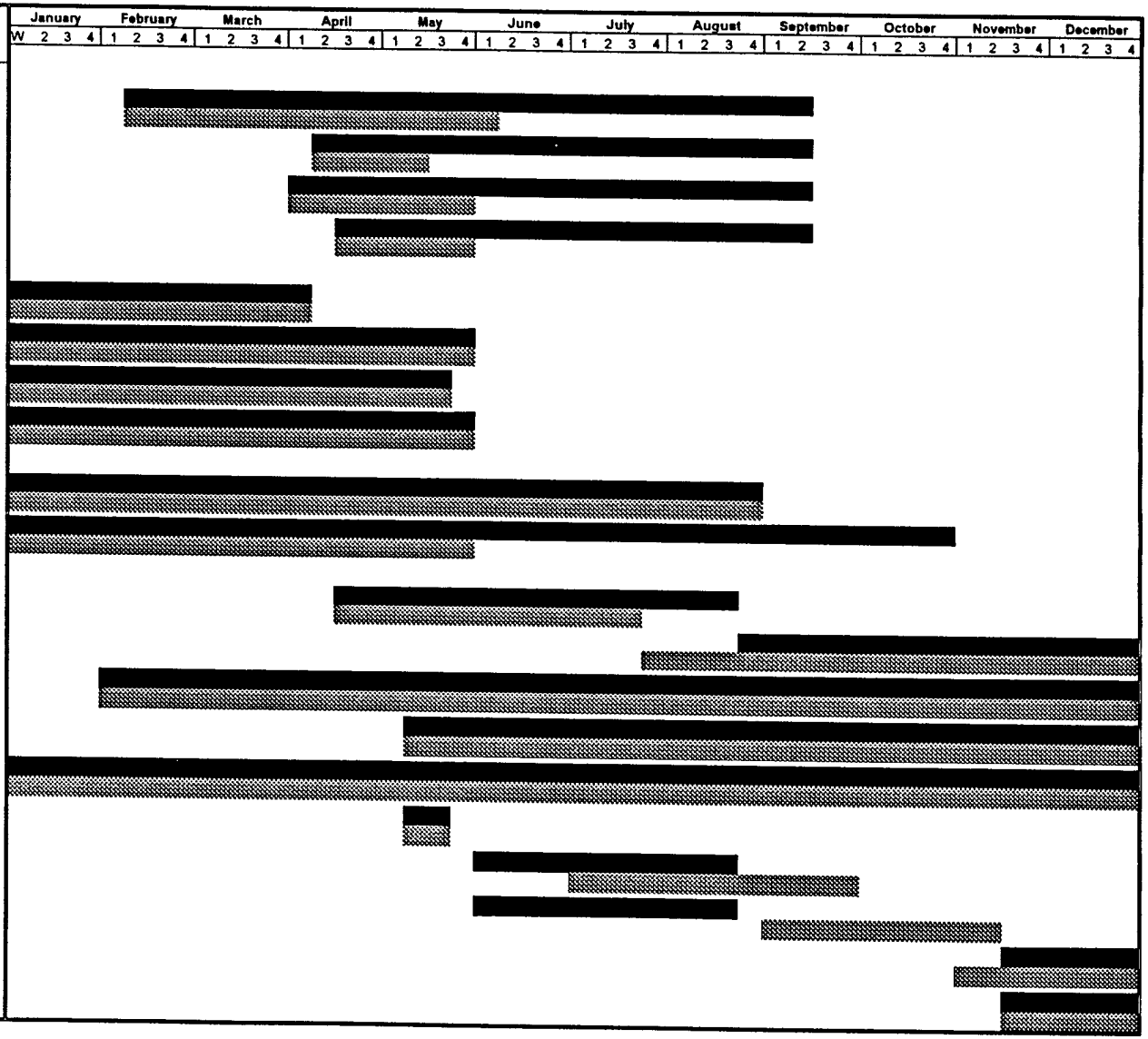
Reliability, Availability, Maintainability (RAM) Database / SHIPNET of SOCP

Schedule	Status Start	Status Finish
1 DATE & SHIPPER V. 2.0 Beta testing at shore based SOCP Sit	1/1/96	6/10/96
	1/1/96	9/30/96
2 Final Modifications of DATE & SHIPPER V. 2.0		
2.1 Code Development	6/10/96	8/16/96
	10/1/96	11/30/96
2.2 Testing	8/16/96	9/16/96
3 Full scale DATE & SHIPPER v. 2.0 Beta testing on board	9/16/96	12/31/96
	2/21/96	9/30/96
4 SPIN & SHIP's RAM softw. development		
4.1 Code development for V. 1.0 Beta	2/1/96	5/12/96
	2/1/96	4/30/96
4.2 Beta tests of V. 1.0 Beta	5/12/96	10/31/96
	5/1/96	9/30/96
4.3 Modification of SPIN & SHIP's RAM	10/31/96	12/31/96
	10/1/96	12/31/96
5 DATE Interfaces		
5.1 Survey to examine current formats	12/1/95	4/30/96
	12/1/95	4/30/96
5.2 VRS Interface for ARCO		
5.2.1 Development of Interface module for VRS	8/20/96	9/5/96
	5/22/96	6/22/96
5.2.2 Test of interface module for VRS	9/5/96	10/5/96
	6/22/96	7/22/96
5.3 MMS Fleetworks Interface for ARCO		
5.3.1 Development of Interface module for MMS Fleetworks	8/16/96	9/30/96
	6/22/96	8/7/96
5.3.2 Test of interface module for MMS Fleetworks	9/30/96	10/31/96
	8/7/96	9/7/96
5.4 Voyage abstract Interface for S/L		
5.4.1 Development of Interface module for EVA	9/15/96	10/15/96
	5/15/96	6/15/96
5.4.2 Test of interface module for EVA	10/15/96	12/31/96
	6/15/96	9/30/96
5.5 AMOS - D Interface for S/L		
5.5.1 Development of Interface module for AMOS-D	9/1/96	10/31/96
	5/15/96	7/15/96
5.5.2 Test of interface module for AMOS-D	10/31/96	12/31/96
	7/15/96	12/31/96
6 Customization of DATE		
6.1 for ETG	4/7/96	12/31/96
	4/7/96	5/22/96
6.2 for ARCO	4/7/96	12/31/96
	4/7/96	5/22/96
6.3 for S / L	5/1/96	12/31/96
	5/1/96	6/1/96



Reliability, Availability, Maintainability (RAM) Database / SHIPNET of SOCP (Cont.)

Schedule	Status Start	Finish
7 Development of Data entry Guidelines		
7.1 General Guidelines	2/9/96	9/16/96
	2/9/96	6/8/96
7.2 Company Specific Guidelines for ETG	4/5/96	9/16/96
	4/5/96	5/15/96
7.3 Company Specific Guidelines for ARCO	4/1/96	9/16/96
	4/1/96	6/1/96
7.4 Company Specific Guidelines for S/L	4/16/96	9/16/96
	4/16/96	6/1/96
9 Site visits for initial surveys		
9.1 ARCO	12/11/95	4/8/96
	12/11/95	4/8/96
9.2 S/ L	12/1/95	5/30/96
	12/1/95	5/30/96
9.3 ETG	11/1/95	5/22/96
	11/1/95	5/22/96
9.4 ABS	1/30/96	6/1/96
	1/30/96	6/1/96
9 Pilot studies for RAM data analysis		
9.1 Feed Pump Pilot Study for ARCO	12/1/95	9/1/96
	12/1/95	9/1/96
9.2 Condensate pump pilot study for ETG	11/1/95	10/31/96
	11/1/95	6/1/96
10 MSTEP Interface		
10.1 Defining Roles	4/12/96	8/21/96
	4/12/96	7/21/96
10.2 Design the Interface	8/21/96	12/31/96
	7/21/96	12/31/96
11 ABS Interface-Phase I	1/30/96	12/31/96
	1/30/96	12/31/96
12 SHIPNET help desk- Phase I	5/10/96	12/31/96
	5/10/96	12/31/96
13 International Ship Network Development- Phase IV	1/1/96	12/31/96
	1/1/96	12/31/96
14 Consensus Meetings at UNO (Guidelines / MSTEP/ SHIPNET	5/6/96	5/22/96
	5/6/96	5/22/96
15 SEM Training	6/1/96	8/21/96
	7/1/96	9/30/96
16 Strategic Planning	6/1/96	8/21/96
	9/1/96	11/15/96
17 Regular RAM DB Population - Phase I	11/15/96	12/31/96
	11/1/96	12/31/96
18 Build one	11/15/96	12/31/96
	11/15/96	12/31/96



APPENDIX H

SOFTWARE APPLICATIONS FOR SHIPBUILDING OPTIMIZATION

GCRMTC PROJECT NO. AMTC95-027A

Principal Investigator: **Norman L. Whitley**
Department of Mechanical Engineering

University of New Orleans
New Orleans, LA 70148

PROJECT SYNOPSIS: This proposal calls for the investigation of current shipbuilding methodology and the incorporation of computer-based procedures in shipbuilding design and manufacture.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$ 143,900
FUNDS REMAINING:	$ 98,084

ACCOMPLISHMENTS THIS PERIOD:

Accomplishments in this period are identified by task below:

TASK 1--Standards/Materials Acquisition.

a. The US Coast Guard Navigation & Vessel Inspection Circulars (NVICs) on CD-ROM and the ABS rules for classification on CD-ROM were acquired. Both of these will be used in our plan to create an expert system to help designers with design standards.

b. The STEP AP's that are important to shipbuilding are available to us through the Internet. They can be downloaded from an 'FTP' site that is maintained by the National Institute of Standards and Technology. We have done so with several AP's and Parts that are necessary for shipbuilding.

c. We have realized that STEP provides us with a structure upon which we can build a class hierarchy for our CAD system. Unfortunately the ISO has been slow to complete the STEP definitions for shipbuilding, and it is not expected that they will be complete within the next 5 to 7 years. We therefore will base most of our class hierarchy on the NIDDESC structure. This structure is being provided to us through NAVSEA-Systems Command - 03R6 - Computer-Aided Engineering. These NSRP standards were sent to us on CD-ROM.

TASK 2--Code Generation.

More graduate students are needed in the lab that are capable of doing high level programming in that lab that are capable of doing high level programming. Both engineering and computer science graduate students and student workers will be hired to meet the needs of the lab.

Unfortunately all of the code generation tasks related to CAS.CADE are behind schedule.

a. The DXF to STEP conversion module. Some progress has been made on this module. Preliminary structure exists and some C++ code has been written. Because progress has been slow in this area we will pursue it along side the basic CAD development.

b. Received 3 days (4/24-4/26) of training from the CAS.CADE application engineer, Claude Hussenet. Have now completed all but the last section of training which entails notions about the persistent data base and how it can be used. Have therefore had good progress in our understanding of the CAS.CADE. environment. The graduate students have used the CAS.CADE environment to develop example packages that exhibit most of the capabilities of the system. These include building a graphical user interface that is interactive, creating objects that possess both geometric and topological features, creating new methods and classes that were not previously there.

TASK 3--Expert System Development.

Prof. Lipp and one graduate student, Pinlin Xuang, are working on this project and will continue to work on it until the graduate student finishes his degree. The scheme as stated in previous reports has not changed. The coding on this project was delayed for a variety of reasons, some of which were software problems. Coding has continued using the software originally acquired for this purpose.

TASK 4--Electronic Data Interchange.

This project did not make ample progress due to a lack of time to commit to it. Discussions with Dick Moore of UMTRI, and Scott Berg of NSnet (held at the American International Shipbuilding Exposition) were informative, and indicated that it is important that NSnet be in on the ground level of any industry-wide EDI effort. It was suggested to the people at NSnet that they propose a project to the GCRMTC in which they would work with the Center on establishing EDI infrastructure, in its numerous manifestations. The GCRMTC will work with them and any other identified group, to make sure that the systems they propose support the latest in information technology and are compliant with our CAD system. It is anticipated that Nsnet will submit such a proposal in the next few months. This is an accomplishment because it is a way of getting this crucial work done in a prompt fashion.

TASK 5--Project Management.

The lack of progress in this area can be attributed to software instability. The laboratory continued to have problems with the VisualWorks development environment in that numerous crashes proved to be disastrous. The origin of these problems is not yet known but it appears to be a combination of file size, the version of Windows/NT we run, and the SCSI interface that we use. We are in the process of changing versions of NT to hopefully address this issue.

It has become obvious that VisualWorks is a powerful environment, but it is an environment that cannot be used secondarily. To run any application that was developed in VisualWorks you need all of VisualWorks. This means that the several hundred megabytes of class library must be installed on the machine, and that the machine must have 32 Mb or more of RAM. It also means that the user must pay ParcPlace/Digitalk on a yearly basis to run their own applications. This may make VisualWorks an unacceptable environment in which to pursue this kind of project, but there are other SmallTalk environments, and other object-oriented programming environments.

TASK 6—Trips/Meetings/Contacts.

a. Attended the American International Shipbuilding Exposition, in New Orleans, LA on (4/11 and 4/12). Contacts were made with various shipyard personnel, and with Scott Berg of NSnet. Several CAD systems were on display including TRIBON and Intergraph's ISDP.

b. Asked to be allowed on the technical review committee of the ongoing project funded through the SP-4 panel of NSRP, "Assessment of World-Class CAD/CAM/CIM Systems." This project is being done by UMTRI and MSD and is being coordinated by Richard Moore of UMTRI. This request was made at the suggestion of Moore. Ron Besselievre, chairman of SP-4 has agreed to this. This will be another avenue for me to use to stay informed on state-of-the-art software systems.

PROPOSED ACTIVITIES NEXT PERIOD:

TASK 1—Improve Productivity

a. More graduate students will be hired. Currently there are 2 graduate students in the lab and there will be a third in the near future. When the fall semester starts, the plan is to have 5 graduate students working in this lab.

b. More money will be expended on hardware/software improvements in the ACLS. Due to various forces the lab needs some peripherals, some upgrades, and some software/hardware additions. These are meant to make the platforms in the lab more stable and more effective - this is absolutely crucial if we are to make any reasonable progress.

TASK 2—CAS.CADE Code Generation.
The centerpiece of the ACLS is the prototype object-oriented CAD system. All of the other pieces are meant to exist in support of it. But because we are behind on the development of this piece, most of the man-hours should be dedicated here until we have a significant accomplishment in this area.

Time will be devoted in this area to development of the class hierarchy structure. The graduate students will be assigned to developing units that reflect the typical structural components of a ship. We will also work on algorithms to convert tables of hull offsets into sets of control points that allow a ship hull to be defined in terms of non-uniform rational b-spline (NURB) surfaces. NURB surfaces are being accepted as the way of transmitting data - they are already a standard part of IGES and STEP. Within the NIDDESC standards there is no standard method for interpreting a table of offsets as a set of NURB surfaces and this is a fundamental item in the design of a ship. It must be addressed if shipyards are to make use of their legacy.

The next training session for CAS.CADE is not yet planned but should be in August.. We now have the capability to pull training materials from Matra over the Internet. As such we have the ability to be ahead of schedule on training. We will request that the training material for the next session be sent to us in early July, so that we can start work on it.

TASK 3--Expert System Development.

It is planned to hire an additional computer science graduate student to continue this work.

TASK 4—Trips/Meetings/Contacts.

Will attend a meeting of the SP-4 panel in Washington, DC on July 17 and 18. At this meeting Richard Moore will present the conclusions of phase I of the UMTRI-MSD project. Plans for the next phase will be addressed.

Will travel to Newport News, VA to visit Newport News Shipyard (NNS) on July 19 and will meet with Sam Tatum, (Program Manager, CAD/CAM Implementation, NNS) and review the VIVID system that NNS and Lockheed have jointly produced. VIVID is an object-based CAD system. It is a piecing together of several off-the-shelf software products. This is meant to be an information sharing meeting. They will learn of our efforts and we will learn about VIVID and gain insight into the current challenges which are creating a suitable drafting system and generating NC code. Future cooperation should come from this.

COLLABORATIVE EFFORTS:	THIS QTR	YTD
$VALUES OF SERVICES FROM INDUSTRY:		
IN-KIND SERVICES:	0	0
ACTUAL FUNDS:	0	0
$VALUES OF SERVICES FROM GOVERNMENT:		
IN-KIND SERVICES:	0	0
ACTUAL FUNDS:	0	0
# OF SIGNIFICANT CONTACTS:		
INDUSTRY:	6	6
ACADEMIC:	0	0
GOVERNMENT:	3	3

SOFTWARE APPLICATIONS FOR SHIPBUILDING APPLICATIONS

TASKS

MONTHS

	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER
EDI PROTOTYPE									
SHIP STRUCTURE CLASS HIERACHY									
DXF TO STEP COMPLIANT MODULE									
DXF TO PARAMETRIC MODULE			DONE						
EXPERT SYSTEM FOR STANDARDS MODULE									
PROJECT MANAGEMENT									
TRPS/MEETINGS/TRAINING									
REPORTS									

APPENDIX I

IMPROVING TECHNOLOGY TRANSFER IN THE SHIPBUILDING INDUSTRY

GCRMTC PROJECT NO. AMTC95-030A

Principal Investigator: **William Lannes, P.E.**
College of Engineering

Co-Principal Investigator: **James Logan, Ph.D.**
College of Business, Department of Management

University of New Orleans
New Orleans, LA 70148

PROJECT SYNOPSIS: The purpose of this project is to develop an improved technology transfer process, incorporating change management techniques, for use in the shipbuilding industry. The deliverables from this project consist of an improved technology transfer process, incorporating industry best practices and current knowledge of organizational change into a matrix evaluation model, and its accompanying implementation protocol. The process incorporates financial, technical, and behavioral factors into a normative model designed to enhance organizational technology transfer. The model is for use by firms in the shipbuilding industry to evaluate current firm practices against best practices and to identify target areas for improvement within a firm. The improved process model identifies significant stakeholders in the technology transfer process and incorporates their needs. The model is customizable to individual firm requirements to insure maximum usability. Additional benefits of this project are the generation of a current, focused data base on the subject of technology transfer in the shipbuilding industry, and increased understanding within both the College of Business and the College of Engineering at the University of New Orleans of a very significant regional industry.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$133,492
FUNDS REMAINING:	$ 97,400

ACCOMPLISHMENTS THIS PERIOD:

1. **Survey data analysis** has been completed for 104 usable surveys. There is some additional data that can be analyzed from the open-ended questions on the survey. That information will be incorporated into the scholarly paper that results from this project. An overview of some of the more interesting points in the survey data was presented at the monthly GCRMTC project briefings.

2. **Change in software authoring system** was made by the team to facilitate the software development and distribution process. FoxPro version 3.0 was purchased during this period. For a more complete explanation, see proposed activities.

PROPOSED ACTIVITIES FOR NEXT PERIOD:

1. **Refine software system** prototype and develop initial protocol for use in shipyards.

The above step was scheduled to have been completed last quarter. After working with C++ as a language for the initial proof of concept software, the team decided that a commercially available

software authoring package, FoxPro version 3.0 would be more effective. This product provides both software development and the ability through the licensing agreement provided with the FoxPro authoring package to distribute the finished product to interested parties in the shipbuilding industry without having to pay additional royalties for use. An important part of this project is to distribute the end product to as wide an audience in the shipbuilding industry as is possible. The software developed with the FoxPro system runs on any Windows® or Windows 95® equipped personal computer, and the user doesn't have to pay a site license or royalty fee of any sort. The team intends to distribute the software and accompanying usage protocol to interested organizations in the shipbuilding industry at the completion of this project.

As part of the consultant's contribution to this project, his company, Omni Technologies, is providing programming services under the direction of the co-principal investigator, Dr. Logan. During this reporting period a significant delay was experienced when Dr. Logan was injured. The software development part of the project was delayed until he could recover enough to resume work on the project. He and Omni Technologies are now working on the project on a priority basis to finish the software authoring task. The Project 30 team has revisited the project milestone schedule and has made adjustments so that the project can still be completed on schedule. Prototype testing has been extended until August 1, 1996. In addition, field implementation has been changed to September 15, 1996. (see revised time line attached). Although the injury to Dr. Logan has impacted this quarter, there should be no effect in subsequent quarters to deliverables or milestone accomplishment.

Many of the tasks that are accomplished by the software consist of either gathering data from the users or looking up data to present to the users. Thus, a data base program that can be modified serves well as the basis for the software system. We decided that the FoxPro Version 3.0 was the best candidate for this use, and have been pleased with the ease of use and ability to change input and output formats as we incorporate what we learn from our survey results and working with industry participants. Although we have had to learn how to use the software, the initial time invested appears to be paying dividends in ease of use and the ability to change information format easily.

In actual use, the software system is used by the various stakeholders in the innovation process. The perceptions of the stakeholders are captured through recording the answers the participants in the process give to the questions asked in the software. The answers the participants in the process give are used for two purposes. First, the answers of the respondents are compared to a set of answers that would be the norm for an innovative company. This is done through a simple additive scale that will allow an overall measure of innovative capacity and also allow evaluation of innovative capacity in several sub-areas that are components of the model. Second, the answers are compared to each other so that the degree of correlation between each of the participants can be determined. By forcing each of the participants in the innovation process to specify their perceptions about important elements of the innovation process or technical innovation being considered, potential problem areas can be identified and dealt with in a much more efficient manner, leading to an improved technology transfer process. The software displays the information both as text and in graphical format, thus facilitating comparison between stakeholders in the innovation process.

2. **Test of model and software** against past technological innovation with industry partners to determine predictive ability and refine measurement capability. We will work with industry partners to determine if our model is congruent with the technology transfer process as it occurred in past instances. If so, we will work with industry partners and other GCRMTC projects to evaluate the model and protocol under field conditions.

3. **Change system and software** to incorporate corrections/improvements suggested by industry participants. This is the ongoing purpose behind the rest of this project and any follow on projects.

4. **Recruitment of additional (volunteer) industry participants** to test refined system and software in fourth quarter. These will be participants in GCRMTC projects as well as interested participants in the shipbuilding industry.

5. **Preparation of scholarly paper** detailing work done on project to date to include significant findings. The findings of this project should be reported in the engineering and management scholarly publications. However, the primary purpose of this project is to work with industry partners to improve the technology transfer process.

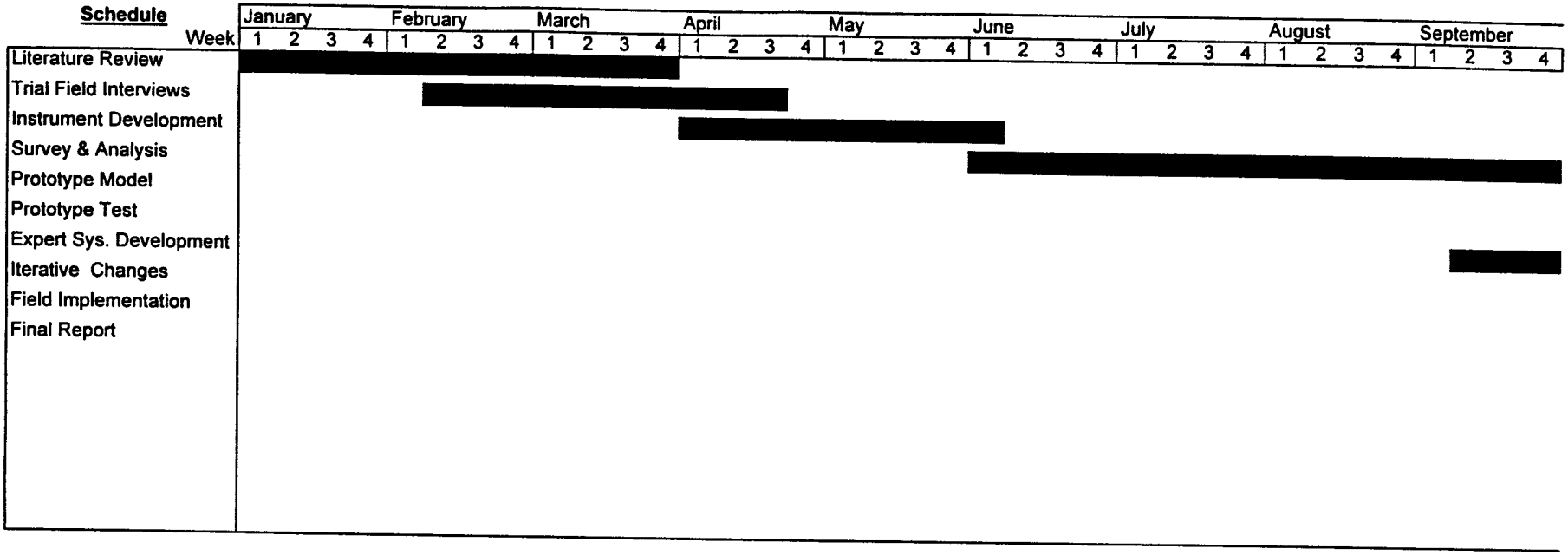
COLLABORATIVE EFFORTS:	**THIS QTR**	**YTD**
$VALUE OF SERVICES FROM INDUSTRY:		
IN KIND SERVICES:	–	$2000.00
ACTUAL FUNDS:	–	–
$VALUE OF SERVICES FROM GOVERNMENT:		
INKIND SERVICES:	–	–
ACTUAL FUNDS:	–	–
# OF SIGNIFICANT CONTACTS:		
INDUSTRY:	11	117
ACADEMIC:	3	7
GOVERNMENT:	3	3

COMMENTS:

Most contacts and in kind time contributions were made in the first year of this project. Additional industry contacts will be made in current phase of project as the system is used with industry participants.

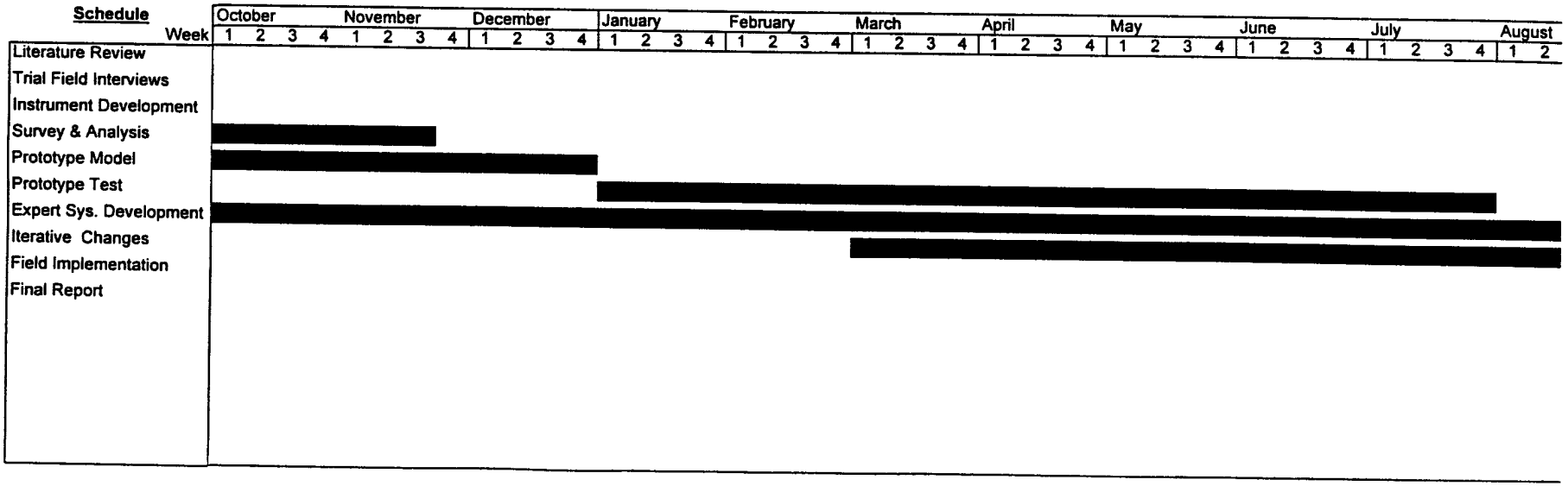
Title THE USE OF CHANGE MANAGEMENT TO IMPROVE TECHNOLOGY TRANSFER IN THE SHIPBUILDING INDUSTRY - PROJECT 30

Schedule



Title THE USE OF CHANGE MANAGEMENT TO IMPROVE TECHNOLOGY TRANSFER IN THE SHIPBUILDING INDUSTRY - PROJECT 30 (Cont.)

Schedule



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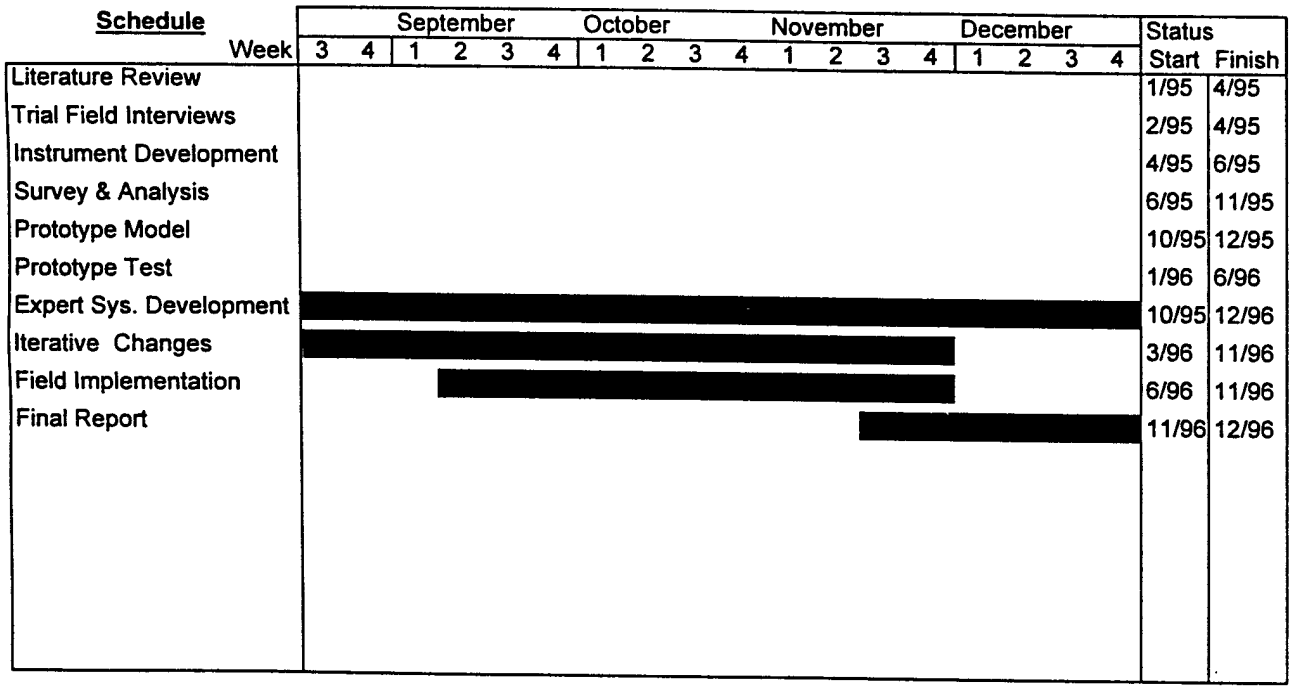
Schedule



	Status	
	Start	Finish
Literature Review	1/95	4/95
Trial Field Interviews	2/95	4/95
Instrument Development	4/95	6/95
Survey & Analysis	6/95	11/95
Prototype Model	10/95	12/95
Prototype Test	1/96	6/96
Expert Sys. Development	10/95	12/96
Iterative Changes	3/96	11/96
Field Implementation	6/96	11/96
Final Report	11/96	12/96

APPENDIX J

DIGITAL IMAGE PHOTOGRAMMETRY

GCRMTC PROJECT NO. AMTC95-035A

Principal Investigator: **Clifford J. Mugnier**
Department of Civil and Environmental Engineering

University of New Orleans
New Orleans, LA 70148

PROJECT SYNOPSIS: A problem in modular shipbuilding is the lack of a reliable and quick method of obtaining and utilizing dimensional control. Photogrammetry has been successfully used as a tool for this application, but because of the large number of systematic errors associated with film-based cameras; only very large shipyards have attempted this. Recently, developments in Charge Coupled Device (CCD) imaging arrays for cameras have allowed some success in applying photogrammetric techniques *without film* in dimensional control. The software and hardware configurations have been expensive and complicated. Digital camera systems and computers will be purchased and programmed to tie existing inexpensive software packages originally designed for mapping into a tool for production shipyard fabrication dimensional control.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$327,017
FUNDS REMAINING:	0

ACCOMPLISHMENTS THIS PERIOD:

TASK I - Industry survey of Instrumentation & Techniques in Accuracy Control

100% Complete.

TASK II - Software development & integration

100% Complete.

TASK III - Field Implementation & integration - 100% Complete.

Accomplishments April-June 1996

1.) Double hull stern tanker section photographed, surveyed and delivered to Avondale. Informational photographs were taken of a mid-body section under fabrication at Avondale Shipyards (Figure 1). Plans have been made to use the digital camera system in providing dimensional control after an existing ship is cut for later mating to the new mid-body section.

As of the end of the period of funded research for this project, the existing ship stern has just been photographed in the dry dock at Avondale Shipyards (Figure 2). Tests were made for target visibility with excellent results. Camera distance was approximately 88 feet from the mating surface of the stern section and a 28mm wide-angle lens was used. This particular focal length was chosen because of the physical constraints imposed by the size of the interior of the dry dock.

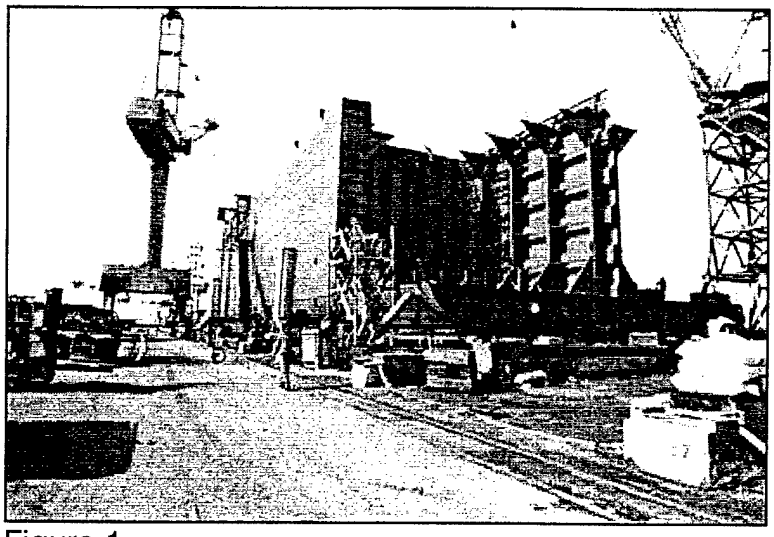


Figure 1

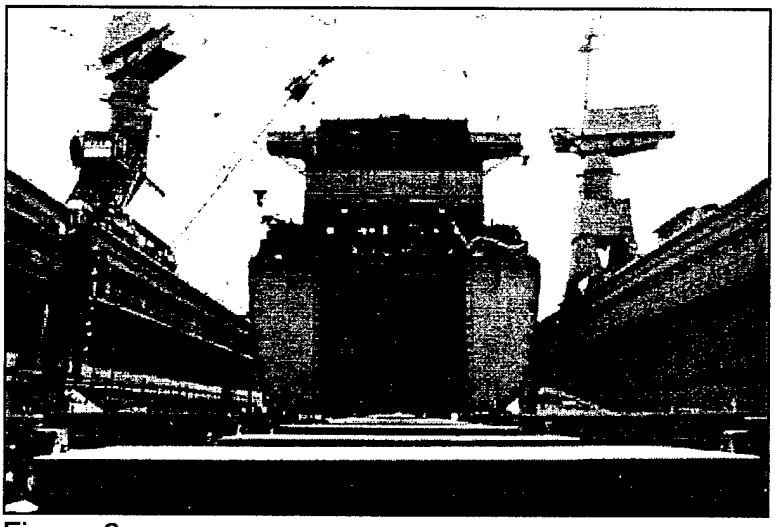


Figure 2

Targets were Avery Color Coding Labels (1¼" Round). The beige ship color required "Red Glow" (Avery 05497-2020RG) for contrast. A return trip was made to the dry dock and Avondale Shipyards made a cherry picker available for the photography session. Avondale personnel placed the "Red Glow" target stickers (one hour) at the locations where coordinates were desired by the Accuracy Control Section. Photos were taken at nine locations with 100% overlap such that practically every control point and unknown point ("pass point") appeared in each of the nine convergent photos (one hour). Resulting accuracies were X= ±0.016 inches, Y= ±0.433 inches, Z= ±0.014 inches (four hours for analysis) and were deemed acceptable.

2.) "As-Built" tugboat hull offsets. A.K. Suda, Inc., *Consulting Naval Architects,* needed to determine the "as-built" dimensions of an existing tugboat (M/V J.K. McLean) in order to compute the stability characteristics of the vessel. Desired overall accuracy was ± ½ inch for all three components (X-Y-Z), and speed of measurement was a major concern in order to ***minimize the charges for dry dock rental time*** (Figure 3).

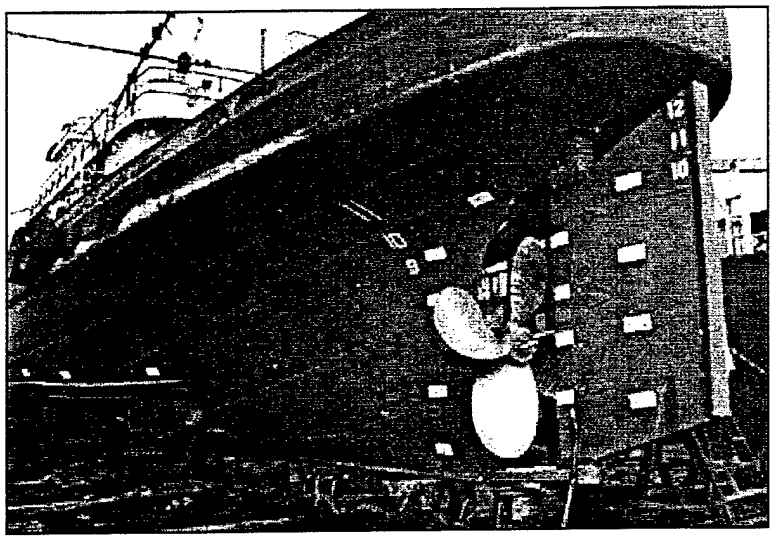
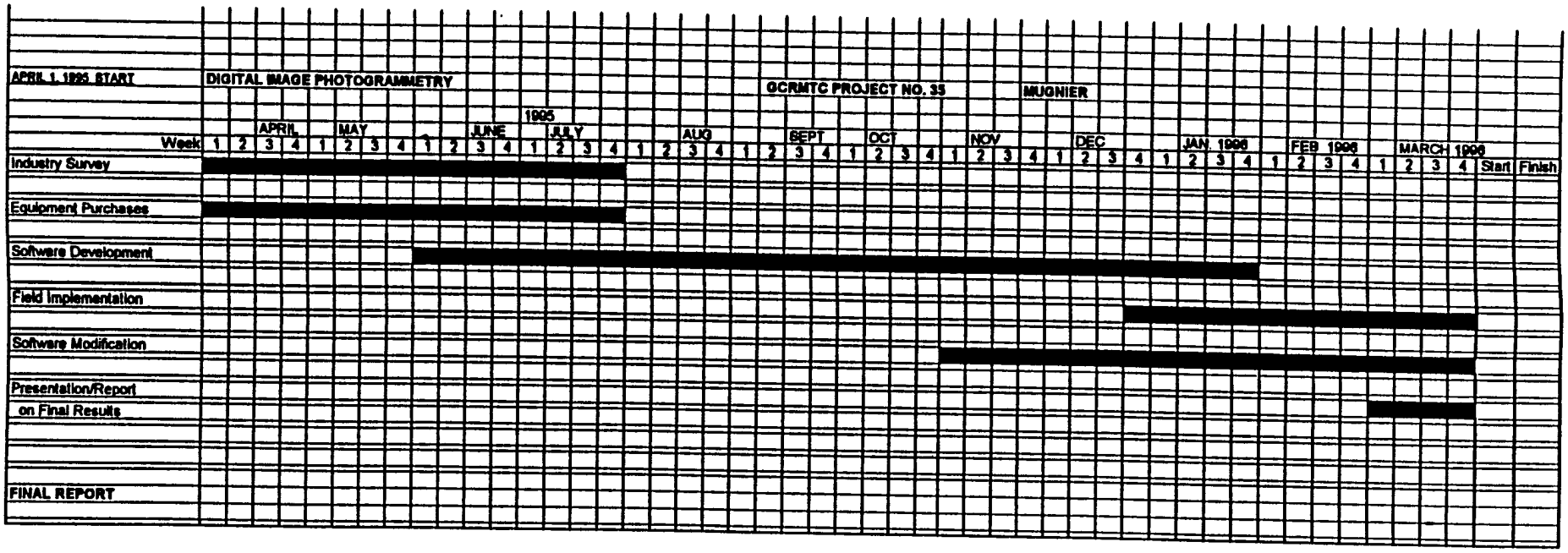


Figure 3

The vessel was available at 12:30 pm, and three men started targeting the bulkhead locations with 13/32 inch diameter Scotchlite™ reflective tape. The targeting operation took a total of 4½ hours. Four object space control points were surveyed with the aid of a 100 foot steel tape and an automatic level. The X-Y-Z control was completed in 15 minutes. A total of 52 photographs were taken with electronic flash in 15 minutes. **Total dry dock time was 5 hours**. Of the 52 photos taken, 26 were actually used in the photogrammetric analysis. Photogrammetric analysis time totalled 48 hours because of two blunders - one blunder in the reduction of the object space control points (approximately one foot), one blunder because of duplicate point identifications assigned during the measurement phase. Thirty seven hours were wasted because of human error; actual productive work *would have taken* about 12 hours *if* there were no blunders. Final accuracy was ±0.33 inches in X (lengthwise along the keel), ±0.0.35 inches in Y (width offsets perpendicular to the keel) and ±0.20 inches in Z (vertical).
The principal investigator was informed that it would have taken 2 men several days to accomplish the same task with traditional tools and the same accuracy.
Note that the blunders were made in the office and were corrected in the office.

COLLABORATIVE EFFORTS:	**THIS QTR**	**YTD**
VALUE OF SERVICES FROM INDUSTRY	$1500[1]	$4200
IN KIND SERVICES FROM INDUSTRY	$3000[2]	$5700

[1] Naval Architecture Department personnel from A.K. Suda, Inc.
[2] Accuracy Control Department personnel from Avondale Shipyards


APRIL 1, 1995 START
DIGITAL IMAGE PHOTOGRAMMETRY
GCRMTC PROJECT NO. 35
MUGNIER
1995
Week
APRIL
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JUNE
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AUG
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OCT
NOV
DEC
JAN. 1996
FEB 1996
MARCH 1996
Start
Finish
Industry Survey
Equipment Purchases
Software Development
Field Implementation
Software Modification
Presentation/Report
on Final Results
FINAL REPORT

APPENDIX K

SHIP CAPSIZING (AN ACCURATE AND EFFICIENT TECHNIQUE TO PREDICT SHIP ROLL DAMPING)

GCRMTC PROJECT NO. AMTC-036A

Principle Investigator: **Jeffrey M. Falzarano**
Department of Naval Architecture and Marine Engineering

Co-Principle Investigator: **Richard A. Korpus**
Senior Research Scientist, Marine Hydrodynamics (SAIC, Ship Technology)

Additional Researcher: **Robert M. Fithen**
Department of Mechanical Engineering

University Of New Orleans
New Orleans, LA 70148

PROJECT SYNOPSIS: This project will develop an accurate and efficient technique to predict ship roll damping using the Finite Analytic Reynolds Averaged Navier Stokes (FA-RANS) solution technique. This capability will be used to improve naval and commercial hull form design with regards to minimizing the most critical resonant roll motions and loads. The approach to be utilized will be to apply progressively more accurate yet computer intensive approximations. Comparisons will be made with existing results and data to be obtained from model and full scale tests. Extensive use will be made of existing SAIC capability and UNO experimental and computer resources including the newly installed UNO Cray J916.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED	$222,296
FUNDS REMAINING:	$192,819

ACCOMPLISHMENTS THIS PERIOD:

During this quarter we have continued work on the second year's tasks which include work in three areas: development, applications and validation.

1) Development:

Completed Level-1* 2-D free-surface capability and incorporation into FA-RANS code.
Continued trans-finite interpolation development, and moving grid capability.

(* "Level-1 Free-Surface Capability," consists of a submerged body in the neighborhood of the free-surface. This should be useful for predicting the hydrodynamic force on submerged pontoons such as the hulls of semi-submersible McDermott crane vessels. In order to analyze floating bodies with finite amplitude motion, we are developing a trans-finite interpolation scheme which will allow re-gridding as the body and the free-surface deforms.)

2) Applications:

Continued extending systematic series and discussed with P. Mukerjee and P. Dixon about undertaking a McDermott application including comparison with model tests results that they have available.

3) Validation:

During this quarter we compared our results with Vugt's published results

We have presented a paper at the 15th ASME OMAE which summarizes some of the results completed for last year's effort. It is attached to this report.

PROPOSED ACTIVITIES NEXT PERIOD:

1) Development:

Begin 3-D unsteady and 3-D unsteady with forward speed.

2) Applications:

Will continue extending systematic series and begin undertaking a McDermott application including comparison with model tests results that they have available.

3) Validation:

During the second year we intend to undertake model tests to compare with our numerical results. These comparisons will include global force comparisons and flow details. We also plan to undertake some full scale comparisons with a McDermott vessel when one is available.

TIMELINE PROGRESS

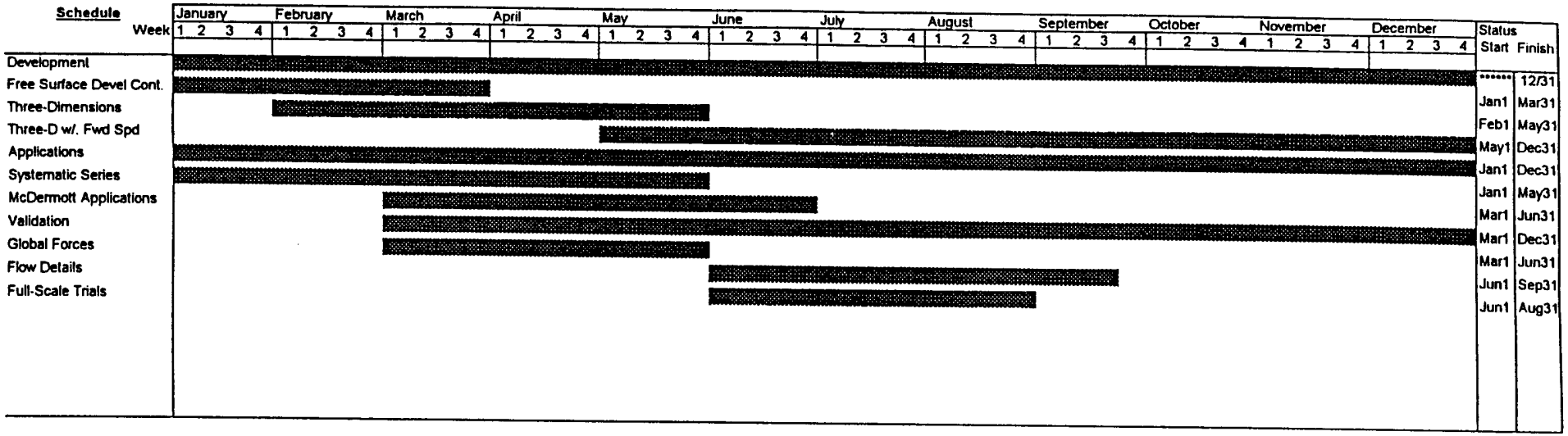
The original and modified timelines are included for reference. The timeline has been modified to reflect the fact that the McDermott application will continue until the end of summer.

COLLABORATIVE EFFORTS:

		THIS QTR	YTD
$ VALUES OF SERVICES FROM INDUSTRY:			
IN KIND: Mr. Mukerjee (Chief NA McDermott)	@$160/hr	$800	$1,600
and Mr. Dixon, (Staff NA McDermott Offshore)	@$50/hr	$500	$500
ACTUAL FUNDS: (none)		n/a	n/a
$ VALUES OF SERVICE FROM GOVERNMENT:			
IN KIND:		n/a	n/a
ACTUAL FUNDS: (none)		n/a	n/a

OF SIGNIFICANT CONTACTS

INDUSTRY: Mr. Mukerjee (McDermott Offshore),
Dr. Kokinias (Exxon PR)
ACADEMIC: Prof. Yeung (UC Berkeley), Prof. Cheung (Univ. of Hong Kong)
GOVERNMENT: H. Chatterton (NAVSEA), B. McCrieght (DTRC)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Development
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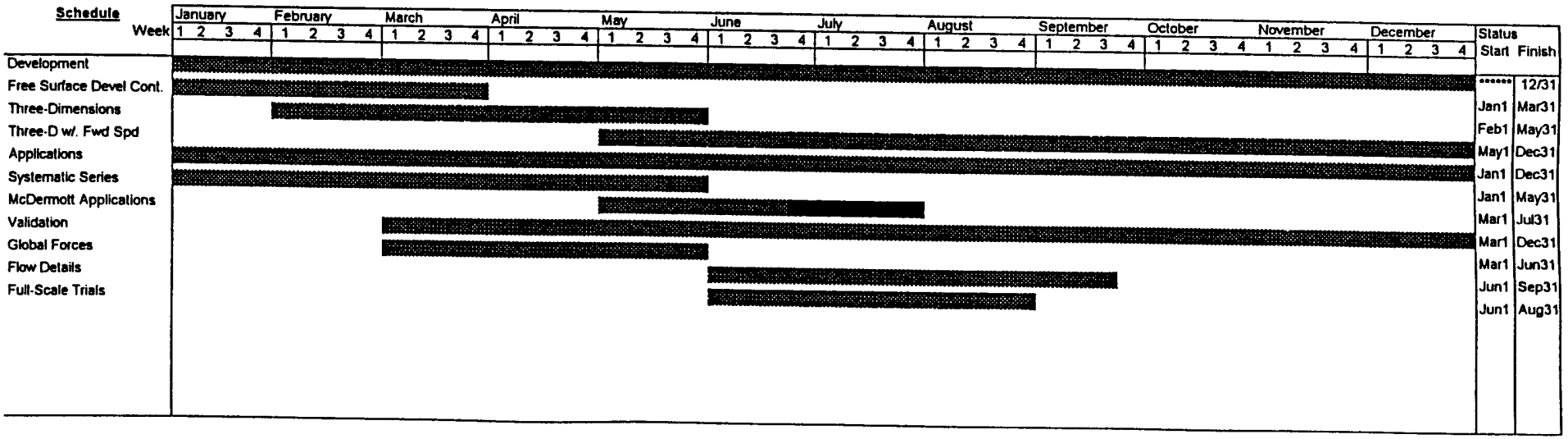
Three-D w/. Fwd Spd Feb1 May31
Applications May1 Dec31
Systematic Series Jan1 Dec31
McDermott Applications Jan1 May31
Validation Mar1 Jun31
Global Forces Mar1 Dec31
Flow Details Mar1 Jun31
Full-Scale Trials Jun1 Sep31
Jun1 Aug31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Free Surface Devel Cont. ****** 12/31
Three-Dimensions Jan1 Mar31
Three-D w/. Fwd Spd Feb1 May31
Applications May1 Dec31
Systematic Series Jan1 Dec31
McDermott Applications Jan1 May31
Validation Mar1 Jul31
Global Forces Mar1 Dec31
Flow Details Mar1 Jun31
Full-Scale Trials Jun1 Sep31
Jun1 Aug31

APPENDIX L

EVALUATION OF Cr(VI) EXPOSURE LEVELS IN THE SHIPBUILDING INDUSTRY

GCRMTC PROJECT NO. AMTC95-032A

Principal Investigator: **Bhaskar Kura**
Department of Civil & Environmental Engineering

Additional Investigator: **Charles Null**
NAVSEA, SCA 03M2

University of New Orleans
New Orleans, LA 70148

PROJECT SYNOPSIS: Occupational Safety and Health Administration (OSHA) is expected to reduce permissible exposure limits (PELs) of Cr(VI) from 100 $\mu g/m^3$ to anywhere between 5 to 0.5 $\mu g/m^3$. A study conducted by the Navy/Industry Task Group organized by NAVSEA revealed that impact of proposed regulations on the shipbuilding industry is significant. The study concluded that the cost of compliance by Navy facilities is as much as $ 46 Million/year besides a one-time cost of about $ 22 Million. Also, the task group estimated that cost of compliance by private shipyards is $ 37 Million/year besides a one-time cost of $ 9 Million. They submitted the study results to OSHA for its consideration while developing the standards.

The main objective of this project is to support the Navy/Industry Task Group activities by, (1) generating additional exposure data for selected shipyard welding processes and (2) evaluating techno-economic feasibility for compliance. The project duration is two years. Project activities include, (1) identification of welding processes for workers' exposure assessment, (2) identification for processes, monitoring, and analysis, (3) sample collection, (4) analysis of airborne particulate samples for Cr(VI) using OSHA's method 215, and (5) evaluation of techno-economic procedures for complying with OSHA's standards. The first four tasks will be completed during the first year. Techno-economic evaluation will be done in the second year.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$ 92,347
FUNDS REMAINING:	$ 83,214

ACCOMPLISHMENTS THIS PERIOD:

Task 1: Identification of Welding Processes for Workers' Exposure Assessment

- Discussions were held with Mr. Charles Null of NAVSEA, Mr. Harvey Castner of Navy Joining Center, and Mr. David Rice of Newport News Shipbuilding (NNS) on welding processes to be investigated.

- Contractual documents were submitted by NNS that describe scope of work and the budgetary requirements.

- A total of three welding processes were identified for exposure assessment. These welding processes are, (1) Gas Metal Arc Welding (GMAW) using solid wire on HY 100 metal, (2) Flux Cored Arc Welding (FCAW) on HY 100 metal, and (3) FCAW on DH-36 Steel (ABS Grade). Funding approved by GCRMTC will only cover the expenses toward the first two welding processes. Additional budget of $ 8,000 will be required to work on

the third welding process. GCRMTC will be asked to provide the additional funding after receiving an estimate from NNS on the field expenses.

- Subcontracting with NNS is being processed by UNO's Office of Research and a contract will be signed shortly.

Task 2: Identification of Support on Processes, Monitoring, and Analysis

- Necessary arrangements were reviewed for airborne Cr(VI) sampling and analysis at NNS. NNS, routinely, does work on all the welding processes that are of interest in this project. NNS has the necessary equipment and personnel experienced in assisting the UNO Team in sample collection during welding operations. Airborne dust samples will be analyzed for Cr(VI) using OSHA Method 215.

- OSHA Method 215 dealing with analysis of airborne dust samples using Ion Chromatograph (IC) equipped with UV Detector were reviewed.

- Materials required for the sampling were identified and will be kept ready by NNS for the sampling task.

- A laboratory capable of airborne dust analysis for Cr(VI) has been identified which will be used for the project.

Task 3: Sampling Airborne Emissions of Cr(VI)

- None. This activity could not be initiated in June as the contract was not signed due to minor problems in agreement terms. The work will commence in July 1996.

Task 4: Analysis of Airborne Particulates for Cr(VI)

- None. Same as Task 3, this task could not commence as the contract with NNS was not signed. The task will commence in July 1996 along with the field sampling task.

PROPOSED ACTIVITIES NEXT PERIOD:

1. Visit Newport News to plan and examine on-site arrangements for exposure assessment.
2. Check Quality Assurance and Quality Control (QA/QC) Procedures of sampling and analysis.
3. Initiate the field work and collect air samples for at least one welding process.
4. Analyze airborne samples for Cr(VI) and compare with the proposed OSHA standards.

COLLABORATIVE EFFORTS	THIS QTR	YTD
$ VALUES OF SERVICES FROM INDUSTRY:		
IN KIND SERVICES:	2,000[a]	4,000
ACTUAL FUNDS:		
$ VALUES OF SERVICES FROM GOVERNMENT:		
IN KIND SERVICES:	1,000[b]	2,000
ACTUAL FUNDS:		
No. OF SIGNIFICANT CONTACTS:		
INDUSTRY:	1	2
ACADEMIC:	0	0
GOVERNMENT:	0	1

COMMENTS:

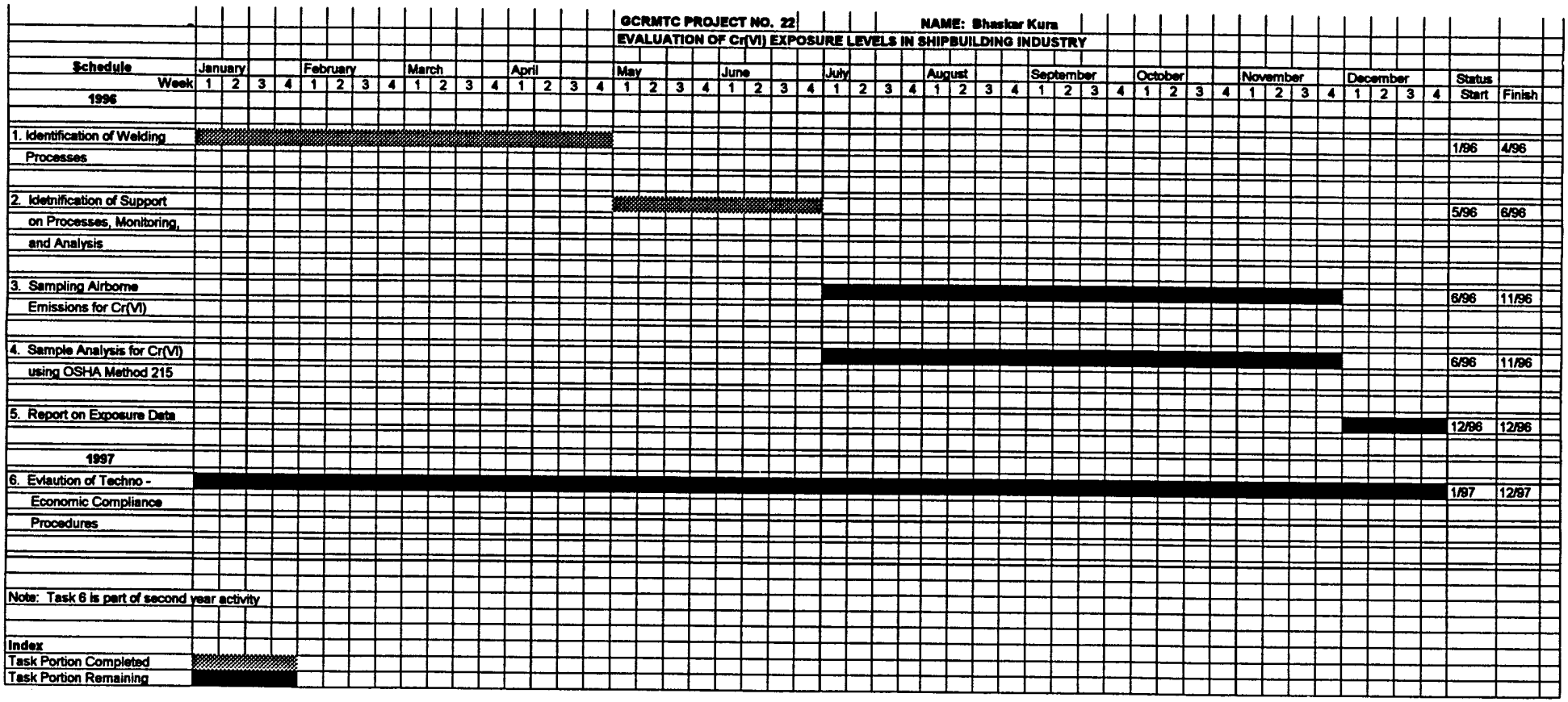
a) Cost of man-hours by the staff of Newport News Shipbuilding Company. Estimated at a total of 20 hours during this quarter. In the previous report, an hourly rate of $ 50 was used which was a conservative estimate. An hourly rate of $ 100 appears to be more reasonable.

b) Cost of man-hours by the Co-P.I. not charged to the project were estimated at a total of 10 hours during this quarter. In the previous report, an hourly rate of $ 50 was used which was a conservative estimate. An hourly rate of $ 100 appears to be more reasonable.

c) Significant industry contact made this quarter is:

Mr. David Rice
Newport News Shipbuilding
4101 Washington Avenue
Newport News, Virginia 23607

Also, some members of the Navy/Industry Task Group (Navy Joining Center, Navy Health and Environmental Center, and Electric Boat) have spent their time on this project. Equivalent in-kind value or contribution is estimated at $ 6,000.


GCRMTC PROJECT NO. 22
NAME: Bhaskar Kura
EVALUATION OF Cr(VI) EXPOSURE LEVELS IN SHIPBUILDING INDUSTRY
Schedule
Week
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January
February
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Status
Start
Finish
1. Identification of Welding Processes
1/96
4/96
2. Identification of Support on Processes, Monitoring, and Analysis
5/96
6/96
3. Sampling Airborne Emissions for Cr(VI)
6/96
11/96
4. Sample Analysis for Cr(VI) using OSHA Method 215
6/96
11/96
5. Report on Exposure Data
12/96
12/96
1997
6. Evlaution of Techno - Economic Compliance Procedures
1/97
12/97
Note: Task 6 is part of second year activity
Index
Task Portion Completed
Task Portion Remaining

APPENDIX M

INTEGRATING FIRE-TOLERANT DESIGN AND FABRICATION OF COMPOSITE SHIP STRUCTURES

GCRMTC PROJECT NO. AMTC95-033A

Principal Investigator: **David Hui**
Department of Mechanical Engineering

Additional Researcher: **Ayman Mosallum**
Department of Mechanical Engineering

Additional Researcher: **Piyush Dutta**

Additional Researcher: **Jesa Kreiner**
Department of Mechanical Engineering

Research Assistant: **Bin Dai**
Department of Mechanical Engineering

Research Assistant: **W. Yip**
Department of Mechanical Engineering

Research Assistant: **Kim-Ho Ip**

University of New Orleans
New Orleans, LA 70148

PROJECT SYNOPSIS: The application of composite materials in commercial and navy ships offers the potential of improved corrosion resistance, reduced life cycle costs, reduction in radiated noise and increased warfare survivability. To quantify these benefits, the US Navy has designed and built prototype structures and showed that they successfully meet shock and fire resistance requirements. The proposed work deals with the integration, design and fabrication of composite materials under flammability conditions, and the purpose is to insure that adequate structural strength is present after the material has been exposed to high temperature flames. The proposed work deals with the development of an analytical technique involving creep deflection of beams made of composite materials, and this analytical technique can be used for predicting the composite material fire tolerance. Some experiments involving specimens tested in the Material Testing System (MTS) machine with an environmental chamber will be conducted to validate the theoretical creep bending model.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$150,000
FUNDS REMAINING:	$130,000

ACCOMPLISHMENTS THIS PERIOD:

CREEP AND DAMAGE MODELING OF COMPOSITES

A thorough literature search on the flammability and creep deformation of structures was conducted and thus far about 100 papers from various journals and conference proceedings were found (see attached list of references). Based on these published papers, it can be conjectured that the creep modeling of the composite materials under flammability conditions would provide key understanding of the response of composite materials under high temperatures. One can also conclude that the damage mechanics modeling of the materials would be the best basic method of approach in the theoretical modeling of composites. The chemical behavior of burned materials will be important to the understanding of the mechanics of burning failure of composites, and subsequent examination of the burned epoxies in the scanning electron microscope will enable one to understand the failure mechanisms and establish realistic failure criterion for the composite structures under flames.

The polymer material for the samples was obtained from British Petroleum and the composite material samples were manufactured from the raw materials. Specifically, the Cellobond J2027L with the Phencat 382 were used to manufactured the composite sample. The first step is to establish the correct proportions of the materials as the gel time varies a great deal with these changes. The use of 2 phr Phencat 382 led to the cure time of 5 days which was

excessive. A few other ratios were used and it appears that the 15 phr which brings the cure time to about one day would be the optimum manufacturing procedure. Approximately eight samples were prepared thus far and many more samples will be manufactured.

CURRENT TASKS IN SAMPLE EXPERIMENTAL MODELING

1. Prepare more samples to be subjected to loading and fire.

2. Evaluate behavior of samples under fire and examine the influence of as many variables as can be determined:
   a. load intensity
   b. exposure time
   c. heat flux

3. Examine and evaluate the changes of microstructure.

4. Monitor the samples and generate complete creep diagrams

5. Examine the influence and improvement of behavior of test samples which were treated with retardant materials.

6. Design of the test rig in two months. It is important to monitor as many parameters as possible, and carefully examine the temperature dependency of these parameters.

Two extended abstracts were accepted for publication at the Third International Conference on Composites Engineering:

Ayman Mosallam,David Hui, Jesa Kreiner, Bin Dai (1996), "Simplified Procedure for Predicting Creep and Recovery of Polymer Composites", ICCE/3, July 21-26, 1996 in New Orleans.

Jesa Kreiner, David Hui, Ayman Mosallam, W.K. Yip (1996), "The Effects of Elevated Humidity on Behavior of Graphite-Epoxy Composites", ICCE/3, July 21-26, 1996 in New Orleans.

THERMAL CONDUCTIVITY OF COMPOSITES

The aim of the project is to predict and test the thermal conductivity of fiber-reinforced composite laminates. Fiber-reinforced composite laminates are widely used in aerospace structures due to their ease of manufacturing, light weight and tailorable properties. However, it is well known that temperature has an undesirable effect on the mechanical properties of these materials. In order to understand the thermoelastic behavior of composites in low and high temperature environments, it is necessary to determine their thermal conductivities.

Two independent thermal conductivities were investigated, one longitudinal and one transverse which were adequate to describe the heat conduction behavior of unidirectional composites. The longitudinal conductivity of a lamina was found to be satisfactorily predicted by the rule of mixtures. Expressions for the transverse conductivity of a lamina are also available. These models include simple models using combinations of thermal resistance, bounding principles and mechanical analogies. They assume a knowledge of the fiber and matrix transverse conductivities, fiber volume fraction and fiber architecture within the matrix (Hashin and Rosen (1964), Springer and Tsai (1967) and Chawla (1987)). Through transformation of heat flux, heat conduction along an arbitrary axis of the lamina can be obtained (Tsai and Hahn,1980). Since a laminate is a stacking of laminae at different angles, the effective thermal conductivity of the resulting laminate can be evaluated.

PROPOSED ACTIVITIES NEXT PERIOD:

The Creep and Damage modeling will be formulated based on existing experimental data on creep deflection of small 3" by 3" size plates made of composite materials. Preliminary analytical modeling will be performed on the creep deflection behavior of composites, based on the known material properties of the samples. Some preliminary experimental data will be obtained from creep tests. The following process has been used in laying up test samples:

1. Cut fiberglass cloth into 9 inch by 3 1/2 inch strips
2. Buff the lexan surface with carnauba wax for mold release
3. Pour 10 ounces of Cellobond J20271 into a paper cup
4. Add 1.5 ounces of Phencat 382 into the paper cup giving a 15 phr ratio
5. Stir the mixture together until thoroughly mixed
6. Pour the mixture on the buffed lexan surface and spread evenly
7. Place one strip of fiberglass cloth on the surface with resin
8. Ensure that the laminate is neither resin rich or poor
9. Repeat steps 7-9 for a total of three plies
10. Remove excess resin
11. Place sample in a ventilated space to cure

The CAL Tester machines will be used with a single point applied load, computer controlled. The fire will be applied directly under the application of the force. Thus, in the worst case scenario, the deflection and stresses will be monitored, and valuable information on the heat flux emanating from the fire source will be recorded. The test rig will be built to accommodate our samples and be adaptable to use with the CaL Tester machines. Both the creep and creep rate of the structure will be measured.

In order to check the validity of the various models, it is desirable to test some bar-typed laminates (Demain, A. and Issi, J. P.,1993). Samples of 165 mm length and 13 x 2 sq. mm. will be prepared. The two ends of the test sample will be inserted respectively into a high and a low temperature chamber. It is intended to maintain a temperature of +80degC and -80degC at the extremes of the specimen. This is achieved by employing an electrical heater and liquid nitrogen. These chambers and the specimen itself are well insulated so that the heat generated by the heater goes completely to the specimen. All thermal contacts will be secured by means of greases. Conductance due to non-compensated radiative losses may also be estimated by testing a pure resin slab of known thermal conductivity. Once the steady-state is achieved, the temperature distribution along the sample will be monitored using thermocouples. Details of such distribution would be inspected through thermography measurements. It should be noted that different parts of the same specimen are under different temperatures, the temperature dependence of the conductivity could be assessed.

COLLABORATIVE EFFORTS:	**THIS QTR**	**YTD**
$ VALUE OF SERVICES FROM INDUSTRY:		
British Petroleum Chemicals, New Jersey		
In Kind Service from Aram Mekjian		
10 hours x $50.00/hour	$500	$500
Actual Funds		
Supply or resins for making the samples	$1,000	$1,000
$ VALUE OF SERVICES FROM GOVERNMENT:		
US Naval Surface Warfare Center, Annapolis, MD (Usman Sorathia)		
In Kind Service 16 hours x $50.00/hr	$800	$800

US Army Cold Regions Research and Engineering Lab , Hanover, NH (Dr. Piyush Dutta)			
In Kind Service	50 hours x $50.00/hr	$2,500	$2,500
Oak Ridge National Laboratory, Oak Ridge, TN (Dr. C.H. Hsueh)			
In Kind Service	10 hours x $50.00	$500	$500

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50 R.E. Lyon Fire safe aircraft cabin materials, fire and polymer, ACS Symposium Series

51 M.M. Hirschler, Fire and Polymer, ACS Symposium Series

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53 A.W. L. Chen (1993), Anelastic Deformation of a Thermoplastic-Matrix Fiber Composite at Elevated Temperature, Journal of Composite Materials, Vol 27,No 9,Sept.,p.862-921

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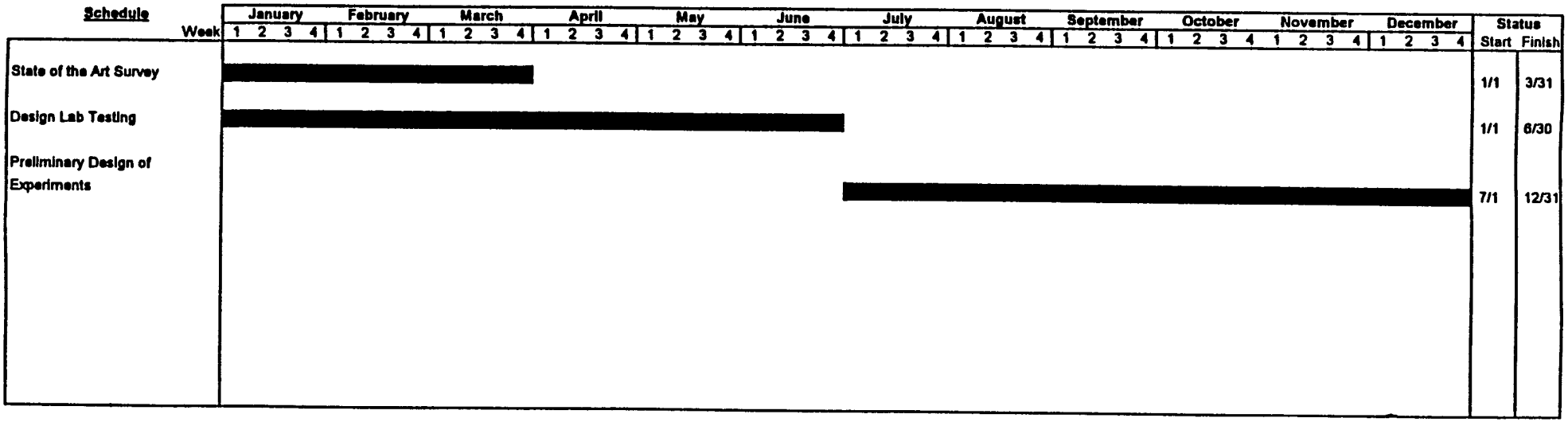
Integrating Fire Tolerant Design and Fabrication of Composite Ship Structures



APPENDIX N

SHOCK REDUCTION OF PLANING BOATS

GCRMTC PROJECT NO. AMTC95-041A

Principal Investigator: **William S. Vorus**
Department of Naval Architecture and Marine Engineering

University of New Orleans
New Orleans, LA 70148

PROJECT SYNOPSIS: The problem addressed is the operational constraints imposed on planing craft by wave impact accelerations. From strength and operational points of view, planing craft can generally operate in a seaway at higher speeds than is the common practice. The speed reducing limitation is imposed by the inability of human occupants to withstand the shock associated with pounding through waves.

The objective of this research is to develop design technology for reducing the impact shock severity aboard planing craft, at the occupant level, and thereby making possible the expansion of boat operating-speed versus wave-height envelopes.

The approach being followed is first theoretical hydro-mechanical analysis of possible innovations. This will be followed by experimental confirmation of the effectiveness of candidate approaches, culminating in prototype development and sea testing.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$147,714
FUNDS REMAINING:	$138,464

ACCOMPLISHMENTS THIS PERIOD:

According to the original approved project proposal and the revised time-line, as explained in the first quarter 1996 report, the first two first year tasks were to be completed in the second quarter 1996 and in the first month of the third quarter. Referring to the revised time-line contained here as Figure 1A the two tasks are: 1) incorporation of the effects of hull strakes (Figure 2) into the theoretical model and, 2) to compare the effects of strakes against drop test data.

Lifting strakes are narrow, flat, generally horizontal extensions to the hull surface at the chine; see Figure 2. The horizontal flat strips are suspected to be particularly effective in increasing lift (and impact force) downstream of chine-wetting (after full-wetting of the contour).

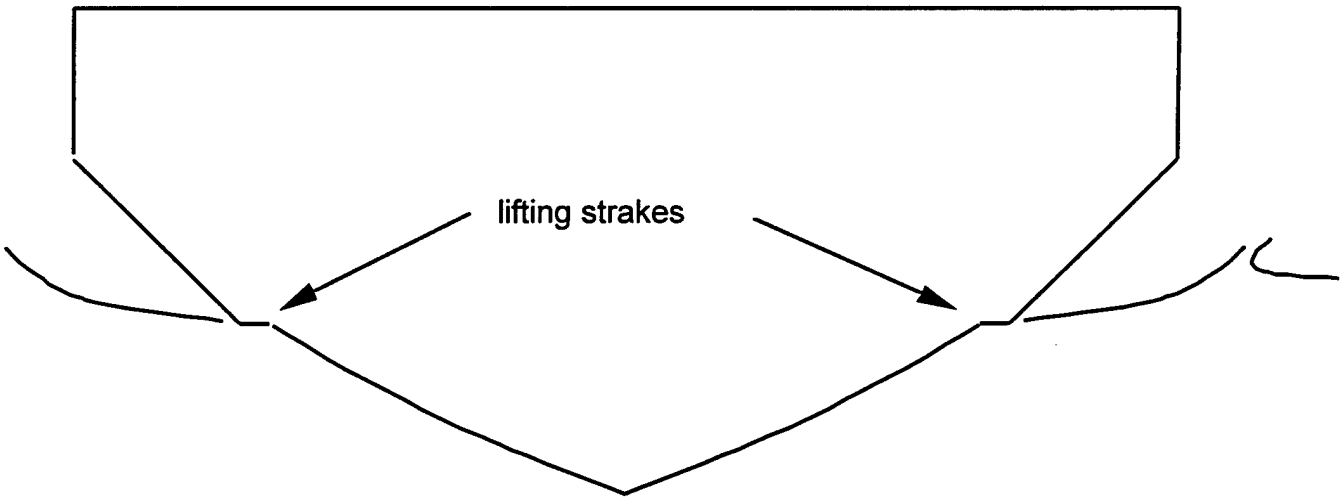


Figure 2: Lifting Strake Arrangement

However, the hydrodynamics of impacting flat strips is complex and in need of understanding and prediction for the success of this research. Therefore, an effort was first expended in June to predict flat strip, or flat plate, impact hydrodynamics. The result is documented in the manuscript titled "Incompressible Impact of a Flat Rigid Strip on Calm Water," which is included herewith as the sub-appendix O-a.

The theoretical understanding gained from this basic study has been followed by the development of the theory and algorithms for predicting the hydrodynamics of planing boat hull strakes (either in wave impact or in steady planing in calm water). This work has been essentially completed and will be documented for publication. Figure 3 is however, a result of computation using the extended predictive tools.

Figure 3 is a plot impact force coefficient per unit length of a cylinder with 20 degrees of deadrise angle (complement of wedge half-apex angle). The cylinder is impacting with constant unit velocity and the cylinder half-beam is also assigned a unit value (the non-dimensionalization is on r, V and Z_{ch}; refer to Vorus, W., "A Flat Cylinder Theory for Vessel Impact and Steady Planing Resistance," Journal of Ship Research, June 1996).

The triangular region of Figure 3 represents a self-similar wedge flow which is not influenced by chine characteristics (strake geometry) prior to chine wetting. Chine wetting is shown to occur on Figure 3 at the non-dimensional time t = .265. The impact force time-history beyond chine wetting is predicted to be quite sensitive to strake width. The prediction with no strake is compared on Figure 3 to that with strakes of width equal to 2 and 6 percent of chine beam.

The total integrated forces (areas under the respective curves) are also listed at the top of Figure 3. The bulk of the total force is from the chine-unwetted region ($C_{Fcuw} = 1.18$), and is strake insensitive. The chine-wetted force contributions to the total are .350, .411, and .448, respectively, for the strake widths of 0, 2 and 6%.

The indication of Figure 3 is that strakes do increase lift, but that a point of diminishing return is quickly reached with increasing strake width.

It must be noted here that the current development does not deal with the issue of flow reattachment once separation at the chine has occurred. Reattachment does certainly occur at some point as the contour penetration deepens indefinitely. Reattachment is believed to be primarily caused by gravity; gravity has been excluded in the dynamics of the applied theory at this point. Reattachment occurs at low force levels and therefore should not be of extreme practical importance in the immediate objectives of the project.

It yet remains in Tasks 1 and 2 to compare predictions typical of Figure 3 with drop test data in validating the predictive capability. Drop-test data is available from recent work performed at NSWC Coastal Systems Station, Panama City, FL. But the comparative work in project Task 2 has been planned as the responsibility of the participating-PI from the University of Michigan. Unfortunately, the Michigan sub-contract is presently stalled in administration. It is hoped that the contractual issues can be resolved to maintain time-line and complete Tasks 1 and 2 on schedule by the end of July.

Strake Width Fraction, %	Integrated Force Coef C_F	Symbol
0	1.53	.
2	1.59	o
6	1.63	*

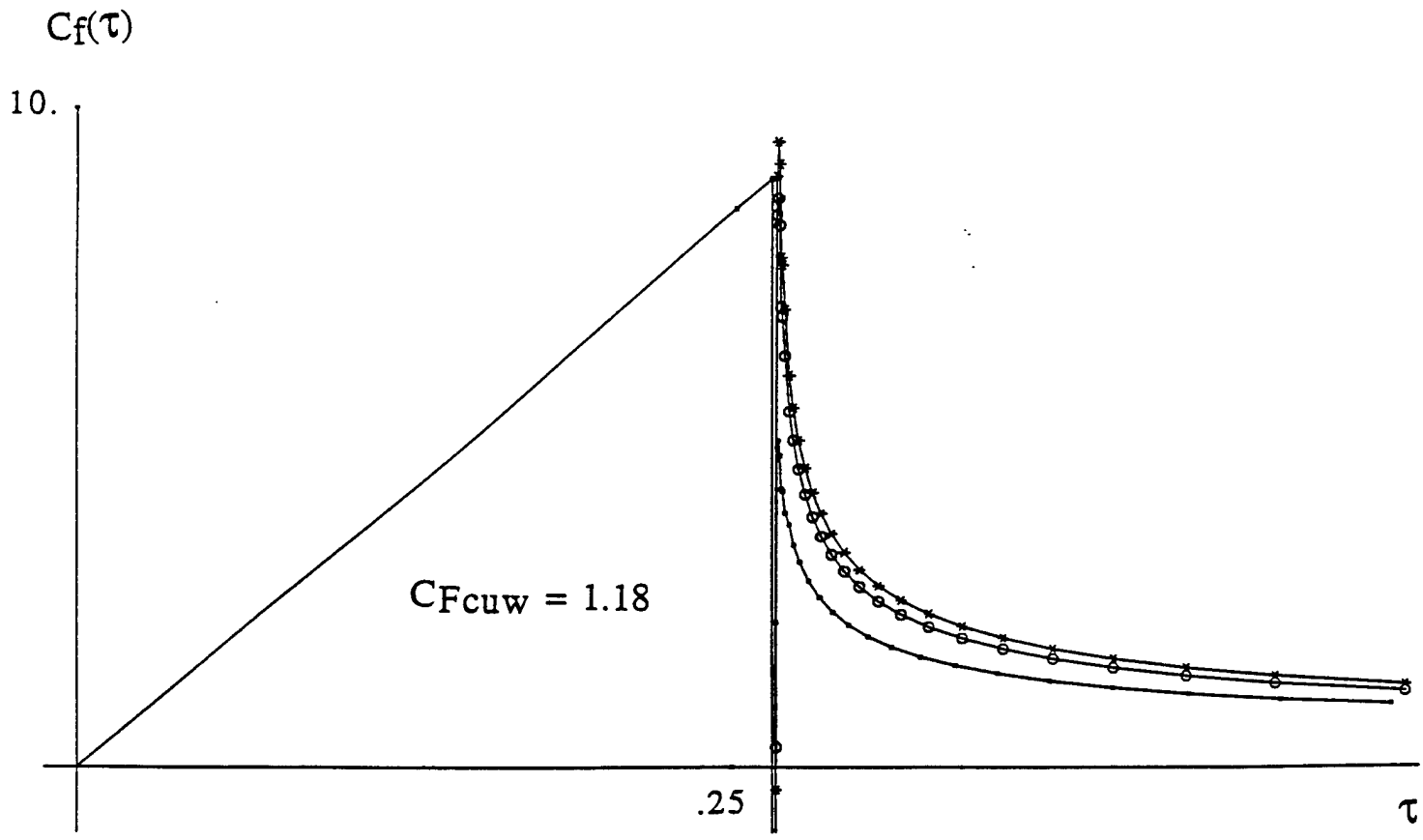


Figure N3: Impact Force versus Time: 20 Degrees Deadrise Contour for Lifting Strake Widths of 0, 2, and 6% of Half-Beam

PROPOSED ACTIVITIES NEXT PERIOD:

Upon verification of the new extended theory, the base predictive tool will be in-hand for addressing innovative concepts and devices for impact force mitigation. The most promising concept involves the development of "smart surface" technology. Figure 4 depicts a simplistic application of the compliant planing surface concept for which preliminary analysis has already begun.

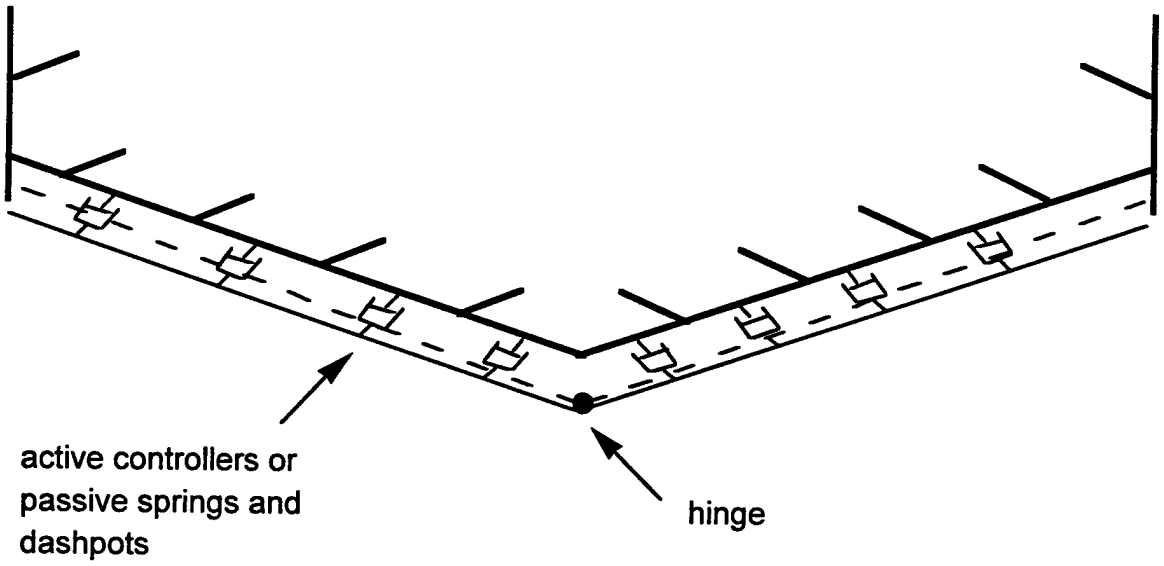


Figure 4: Concept of "Smart Surfaces" for Shock Reduction

It has been found from the analysis to date that, due to the nonlinearity of the large transverse perturbation, impact loads are extremely sensitive to hull geometry. The idea of Figure 4 is to rapidly increase the deadrise angle by a few degrees to produce a suction just as the section is impacting the surface, thereby producing cancellation in the impact force and reducing boat motions and accelerations. Development of this concept requires coordinated research in both hydrodynamics and adaptive control theory. However, preliminary analysis suggests that substantial impact reductions might be achieved with a simple passive system of springs and dampers attached between the internal structure and the compliant outer hull surface.

This effort will become the focus of the project in the fourth quarter 1996.

COLLABORATIVE EFFORTS:	THIS QTR	YTD
$ VALUES OF SERVICES FROM INDUSTRY	0	0
IN KIND SERVICES	0	0
ACTUAL FUNDS	0	0
$ VALUES OF SERVICES FROM GOVERNMENT	0	0
IN KIND SERVICES	0	0
ACTUAL FUNDS	0	0

NUMBER OF SIGNIFICANT CONTACTS:

INDUSTRY: Mr. Anil Raj, Trinity Marine Group

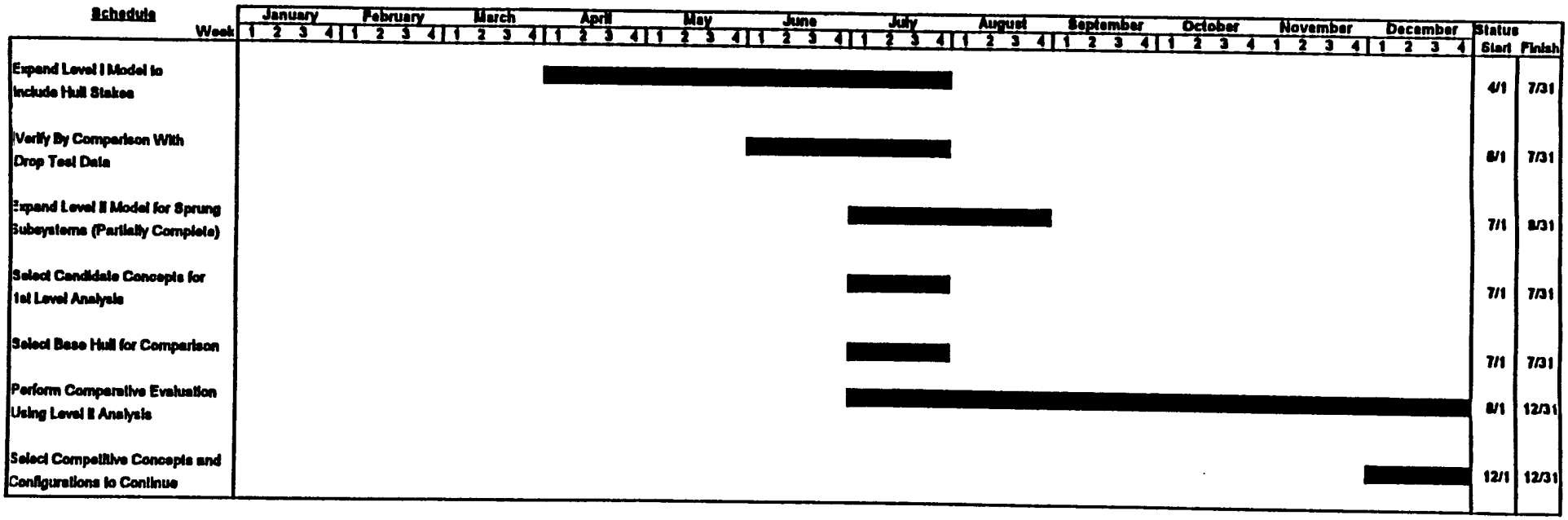
ACADEMIC:

GOVERNMENT: Dr. Ronald Peterson, NSWC-CCS

COMMENTS ON ABOVE:

The Principal Industry Collaborator on the project is Trinity Marine Group, and support of NSWC-Coastal Systems Station (CSS) has also been secured. Data is being provided by CSS for the verification phase of the predictive tools developed, as noted above; this will occur in July. The function of Trinity Marine in the project is to help with demonstration tests of the concepts, and ultimately, to build a prototype system for sea tests. At this time it is not possible to quantify collaborative external effort in 2nd quarter 1996. No substantial in-kind collaborative support of the type to be provided by Trinity will be needed until 1997. The collaborators are however being kept informed of the theoretical progress.

Shock Reduction of Planing Boats 1996 - Figure 1A



APPENDIX O

A PROGRAM FOR MONITORING CPU USAGE IN A DISTRIBUTED COMPUTER SYSTEM NETWORK

GCRMTC PROJECT NO. OR95-004D

Principle Investigator: **Lawrence Osborne / Vinay Saxena**
Gulf Coast Region Maritime Technology Center

Lamar University
Orange, Texas 77630

PROJECT SYNOPSIS: This project proposes to create software that will monitor the CPU usage of a network of UNIX workstations for the purpose of billing users of the system. The collected data will be transmitted to a PC server running Windows/Windows NT, which will organize the information and create reports that can be used by the Center's staff. The software will be designed according to the client-server model. Deamon processes will run in the background on each UNIX workstation to monitor the amount of execution time utilized by each member of the group of remote clients each time a login by one of the members occurs. The primary means of calculating CPU usage will be system calls to the individual workstation kernels. Since the client workstations are running in the UNIX environment and the server will be in Windows environment, it will be necessary to develop an integrated environment in which the primary interface for communications will be general enough that other applications such as database servers can easily be developed by extending the ideas employed in this project.

One major issue in porting applications from a Berkeley sockets environment to a machine running Windows involves the "blocking" of processes that are awaiting a reply from one or more other processes. The default behavior within the UNIX sockets model is for a socket to block unless the programmer explicitly requests that operations be treated as non-blocking. Since UNIX is a multiprogramming system, other processes can continue and execute even if one process does block. Hence if blocking occurs, no other processing can be done until the expected reply arrives. Thus it is necessary to use asynchronous operations if at all possible, since they work much better within the nonpreemptive Windows environment

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$7,329
FUNDS REMAINING:	$ 0

Project funded from Lamar University revenue source.

ACCOMPLISHMENTS THIS PERIOD:

TASK VI:

- software documentation was revised, deployed and tested
- software has been deployed and tested
- project was completed

PROPOSED ACTIVITIES NEXT PERIOD:

Project Complete

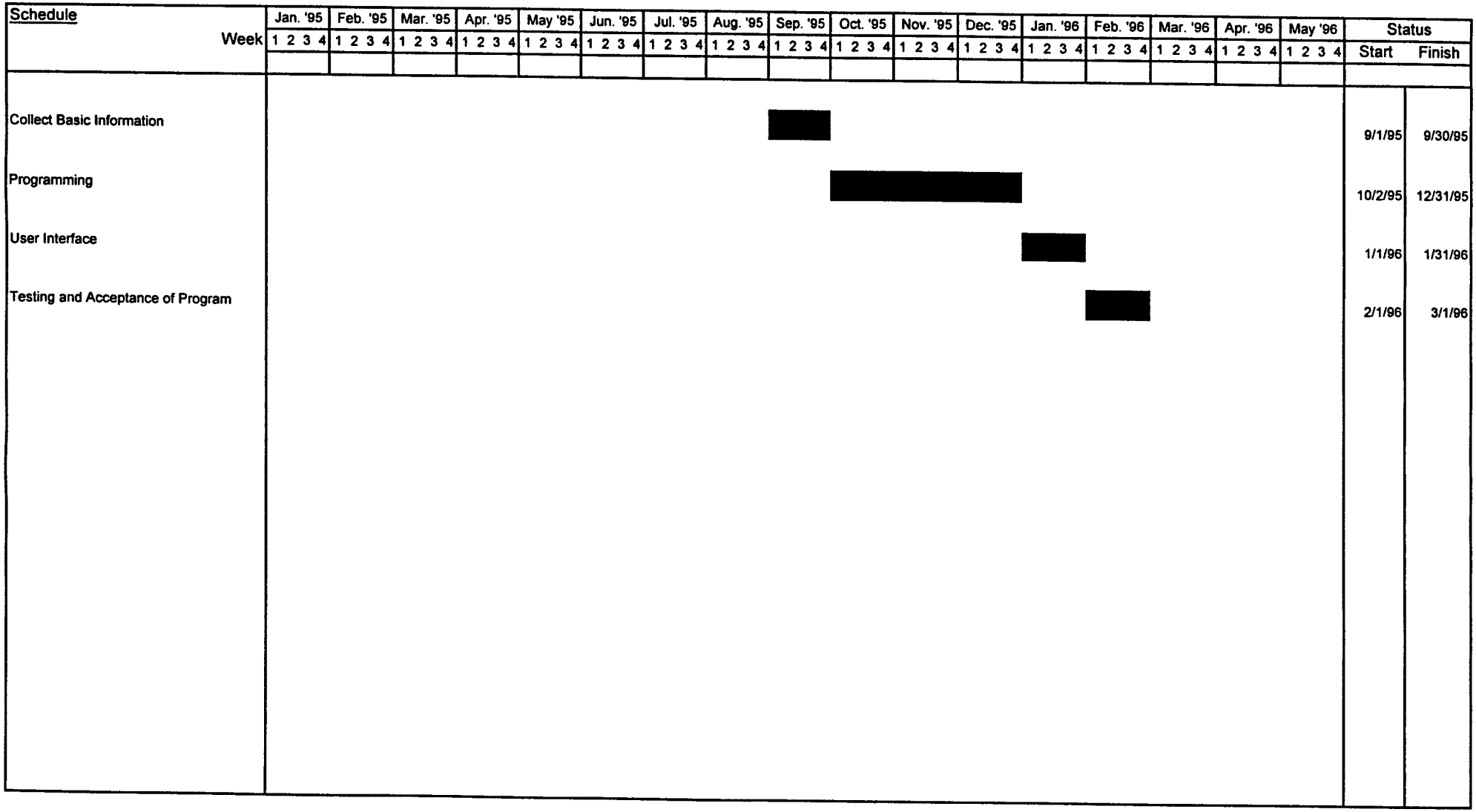
COLLABORATIVE EFFORTS:

	THIS QTR	YTD
$ VALUES OF SERVICES FROM INDUSTRY:		
IN KIND SERVICES:	n/a	n/a
ACTUAL FUNDS:	n/a	n/a
$ VALUES OF SERVICES FROM GOVERNMENT:		
IN KIND SERVICES:	n/a	n/a
ACTUAL FUNDS:	n/a	n/a

OF SIGNIFICANT CONTACTS:

INDUSTRY:	n/a
ACADEMIC:	Engineering faculty and graduate students-Lamar University - Beaumont
GOVERNMENT:	n/a

CPU Usage in a Distributed Network Billing Project



APPENDIX P

BUSINESS PROCESS IMPROVEMENT
GULF COPPER MANUFACTURING, INC.

GCRMTC PROJECT NO. OR95-001A

Principle Investigator: **Patricia R. Pate**
Gulf Cost Region Maritime Technology Center

Lamar University
Orange, TX 77630

PROJECT SYNOPSIS: This project focuses on improving turnaround time on ship repair projects with a Gulf Coast Manufacturing firm. Key issues of the project include improving throughput of repair/conversions, assessing the organizational environment, culture, team participation, and current quality initiatives. Using simulation software, baseline process models will be developed which characterize the current approach to the bid process, planning, materials acquisition, and project management. The Stolt Parcel Tank Modification Project was chosen as the initial project for study. Data has been gathered through the project team, interviews, and team work sessions. Comparisons of the actual model will be conducted with various "what-if" scenarios.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$134,719
FUNDS REMAINING:	$ 10.491

ACCOMPLISHMENTS THIS PERIOD:

TASK VIII: Refine Model and Stabilize

Accomplishments Apr-Jun96.
- Compared simulation with tasks
- Worked with Gulf Copper management and Lamar faculty in refinement of simulation model
- Worked with Gulf Copper management to determine accuracy and completeness of the simulation
- Identified statistical anomalies in software to Aesop (software developer)
- Completed this task this period.

TASK IX: Develop final report

Accomplishments Apr-Jun96
- Worked with project team to complete final report.

Proposed Activities Next period:

TASK IX: Develop final report
- The draft of the final report will be reviewed and appropriately revised.
- The final draft will be copied and submitted per the GCRMTC Procedure Manual

COLLABORATIVE EFFORTS:

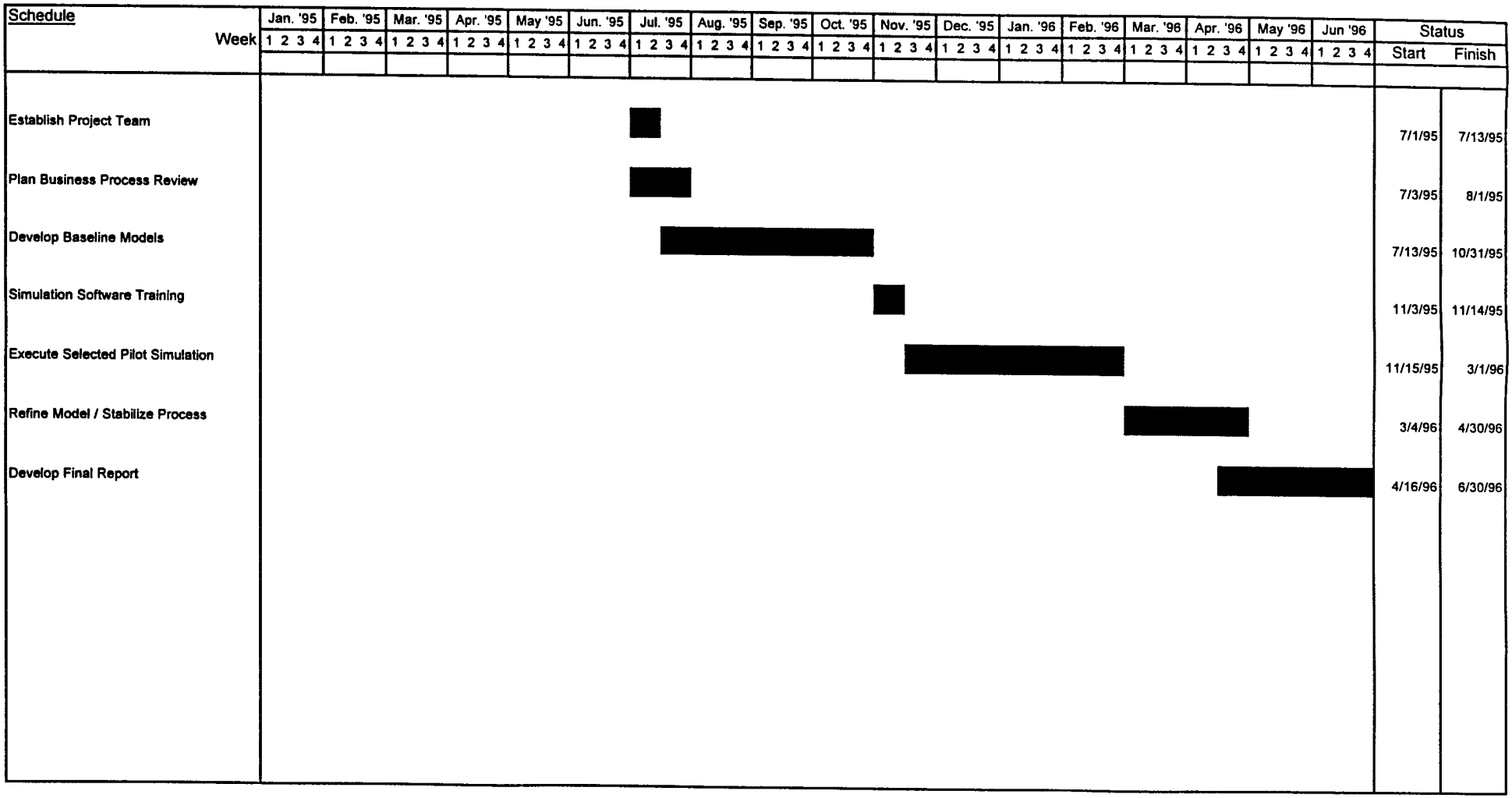
		THIS QTR	YTD
$ VALUES OF SERVICES FROM INDUSTRY:			
	IN KIND SERVICES:	4,810	22,685
	ACTUAL FUNDS:	n/a	n/a
$ VALUES OF SERVICES FROM GOVERNMENT:			
	IN KIND SERVICES:	n/a	n/a
	ACTUAL FUNDS:	n/a	n/a
# OF SIGNIFICANT CONTACTS:			
	INDUSTRY:	Gulf Copper Manufacturing, Inc. Stolt Neilson Company	
	ACADEMIC:	Engineering faculty and graduate students-Lamar University - Beaumont	
	GOVERNMENT:	n/a	

COMMENTS: The ship repair project was begun with full cooperation of Gulf Copper Manufacturing, Inc. the John Gray Institute, and Gulf Coast Regional Maritime Technology Center, Lamar University, Orange. Additionally, collaborative efforts were established with the Industrial Engineering Department at Lamar University- Beaumont.

Aesop has provided technical support throughout this project. They have found this project to be of value in extending its applications and have used the findings to revise their product and demonstrate its capabilities.

The Lamar University faculty have developed a proficiency in the Aesop product and application of this kind of simulation tool to business processes. In addition, Lamar faculty and students have had direct experience with the regional marine industry and have become familiar with the needs of that particular regional industry.

Business Process Improvement Project



APPENDIX Q

JAPANESE CIMS TRANSLATION PROJECT

GCRMTC PROJECT NO. OR95-003C

Principle Investigator: **Bruce Bongiorni/Jeevan Campos**
Gulf Cost Region Maritime Technology Center

Lamar University
Orange, Texas 77630

PROJECT SYNOPSIS: In September and October of 1994, Professor Howard M. Bunch of the University of Michigan, and Dr. Vivek Samant of the Orincon Corporation visited Japanese shipyards. During their visit, Professor Bunch and Dr. Samant met with members of the Japanese CIMS initiative at which time they received a copy of the project final report. The report was written in Japanese and was forwarded to ARPA with Professor Bunch's recommendation that it be translated into English and distributed to the SP-4 Panel and ARPA. The Orange site was directed to translate this document. The translation of the report will be useful to the efforts at the Orange site because it deals with the Japanese efforts to develop integrated product models during ship design and automation of shipyards. Additionally, the report will be useful to the SP-4 Design and Production Integration Panel of the Ship Production Committee in developing and prioritizing its projects.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	15,203
FUNDS REMAINING:	(4,312)

ACCOMPLISHMENTS THIS PERIOD:

TASK III: Provide draft copy of translated document to Professor Bunch, the SP-4 Panel, and ARPA for review.

- Gather reviews from industry, government, and academic representatives and incorporate comments from the prior quarter.
- Complete the final draft and submit to the Executive Director

PROPOSED ACTIVITIES NEXT PERIOD:

Project Complete

COLLABORATIVE EFFORTS:

	THIS QTR	YTD
$ VALUES OF SERVICES FROM INDUSTRY:		
IN KIND SERVICES:	600	1800
ACTUAL FUNDS:	n/a	n/a
$ VALUES OF SERVICES FROM GOVERNMENT:		
IN KIND SERVICES:	n/a	n/a
ACTUAL FUNDS:	n/a	n/a

OF SIGNIFICANT CONTACTS:

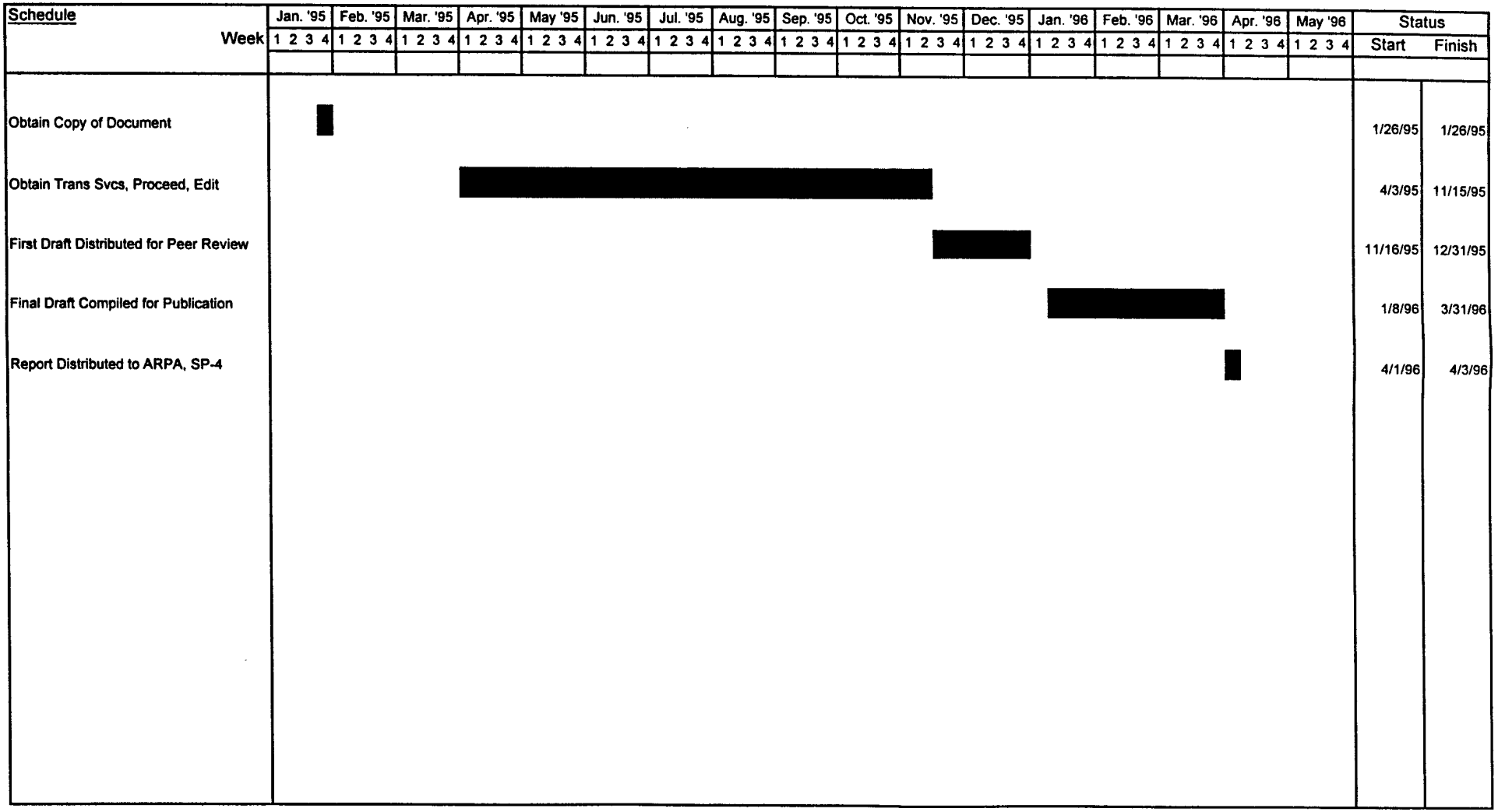
INDUSTRY: 4

ACADEMIC: 12
GOVERNMENT: n/a

COMMENTS: This project has been of significant benefit to the NSRP SP-4 Project currently tasked with reviewing CAD/CAM/CIM technologies in the world shipbuilding industry. Other industry members have found their opportunity to review the draft report has provided them significant insight into the goals of the Japanese shipbuilding industry.

This project has also provided the Orange Site with the opportunity to learn the process of translation of foreign technical documents. It has proved invaluable in building the Orange Site experience base and expertise.

Japanese Translation Project



APPENDIX R

SHIP REPAIR MARKET STUDY

GCRMTC PROJECT NO. OR95 - 002B

Principle Investigator: **Roy Huckaby**
Gulf Cost Region Maritime Technology Center

Lamar University
Orange, Texas 77630

PROJECT SYNOPSIS: This research proposes an extensive analysis of the ship repair market. In addition to providing planning data for Texas Gulf Coast firms, the research will also serve as a model for similar research in other parts of the US. By identifying the number of and type of potential customers, the factors that will make US Shipyards competitive with respect to both cost and time, and the factors that enter into selection of repair firms, this research will permit US shipyards to become proactive in developing business. A strategic advantage will ensue. Through a more aggressive marketing of their services, shipyards should become stronger and provide a greater number of permanent jobs for US citizens.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$132,171
FUNDS REMAINING:	$30,975

ACCOMPLISHMENTS THIS PERIOD:

TASK VI: Prepared Draft Report
- Incorporated comments from peer review
- Submitted draft report to GCRMTC Executive Director.

PROPOSED ACTIVITIES NEXT PERIOD:

TASK VII: On approval of GCRMTC Executive Director and the GPM, publish Final Report
- Find two locations to present this report preferably one local and one national which will accomplish two things: First, the research will become exposed to the local market for which it was intended. Second, the national presentation will demonstrate the report as the model for other regional research of this type.

COLLABORATIVE EFFORTS:

	THIS QTR	YTD
$ VALUES OF SERVICES FROM INDUSTRY:		
IN KIND SERVICES:	2,000	2,000
ACTUAL FUNDS:	n/a	n/a
$ VALUES OF SERVICES FROM GOVERNMENT:		
IN KIND SERVICES:	n/a	n/a
ACTUAL FUNDS:	n/a	n/a

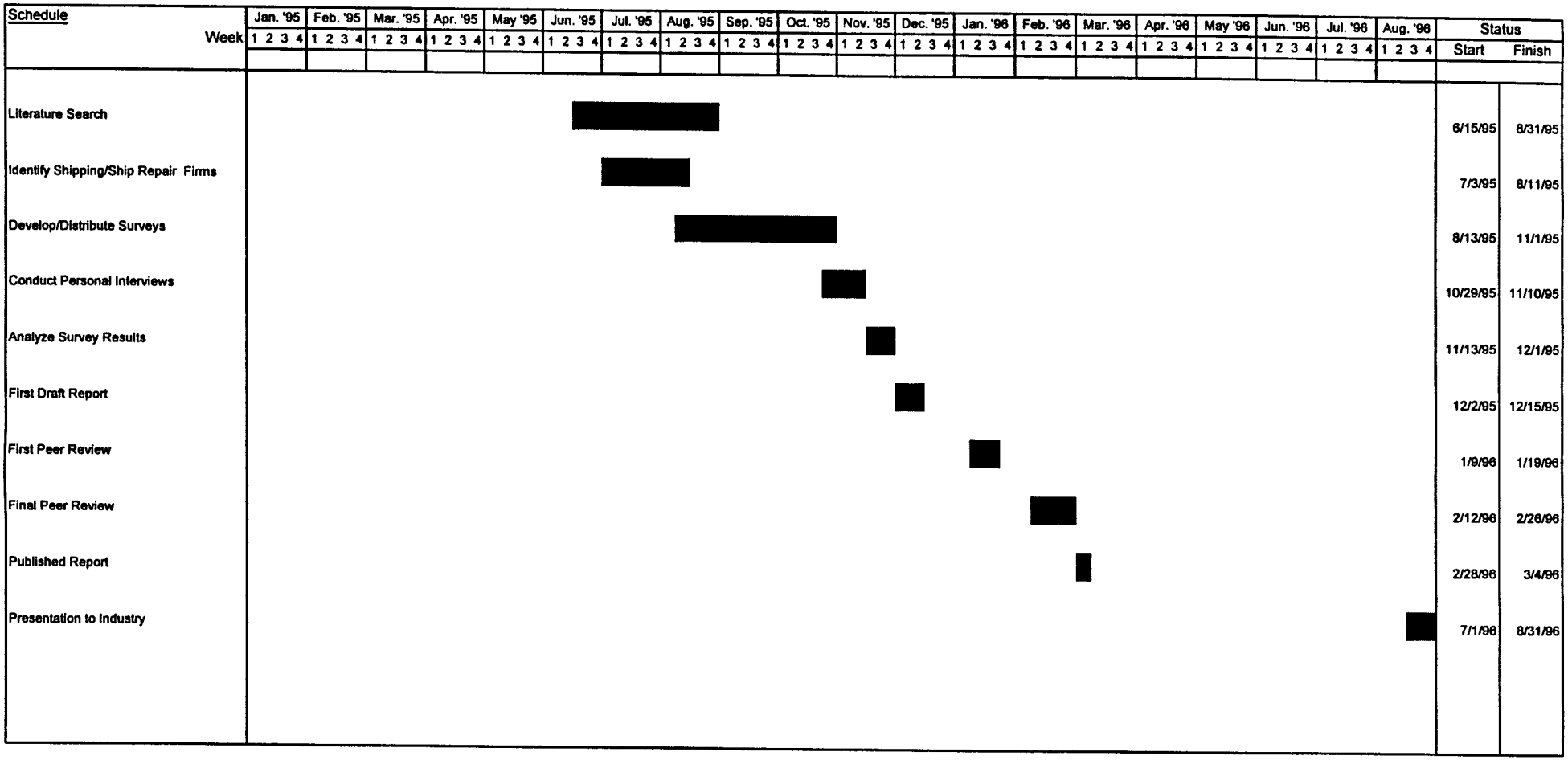
OF SIGNIFICANT CONTACTS:

INDUSTRY:	11
ACADEMIC:	4
GOVERNMENT:	n/a

COMMENTS: This project has provided an insight into the regional ship repair market. It serves as a data point to guide subsequent activities of the Orange Site in support of regional maritime industries. Preliminary findings were incorporated in the Gulf Copper project providing information for planning future business strategies and options.

Lamar University faculty and students involved in this project have developed an understanding of the regional ship repair industry which can serve as a future resource available to the Orange Site.

Ship Repair Market Study Project



APPENDIX S

MARKET RESOURCE CENTER FEASIBILITY STUDY

GCRMTC PROJECT NO. OR95 - 005A

Principle Investigator: **Bruce Bongiorni/H. M. Bunch**
Gulf Cost Region Maritime Technology Center

Lamar University
Orange, Texas 77630

PROJECT SYNOPSIS: The GCRMTC-Lamar University Site Statement of work requires that we "investigate the feasibility of establishing and operating a market analysis and strategic international marketing center, in cooperation with the US Department of State and the US Maritime Administration, for international commercial shipbuilding sales, including development of curriculum and other materials which can be utilized by the shipbuilding industry."

This study will determine the feasibility of a market analysis and strategic international marketing center for commercial shipbuilding and repair. The center would (1) provide basic marketing data, (2) provide analysis of this data for market identification, (3) prepare training for market analysis, and (4) conduct seminars and colloquia for strategic issues relating to market identification and exploitation.

The study plan has five phases:

1. Project Planning
2. Literature Research and Information Gathering
3. Data Analysis and Concept Evaluations
4. Report Preparation
5. Sponsor Presentations

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$140,000
FUNDS REMAINING:	$52,362

ACCOMPLISHMENTS THIS PERIOD:

TASK VI: Completed analysis of information.

TASK VII: Prepared conclusions, recommendations and draft report.
- Completed draft of final report

PROPOSED ACTIVITIES NEXT PERIOD:

The appropriate analyses will be completed for a report of conclusions and recommendations relating to the feasibility of a domestic market resource center commensurate with the Orange site statement of work. The tasks anticipated to be completed in the next period are as follows:

TASK VII: Complete final report.

TASK VIII: Sponsor Presentations.

COLLABORATIVE EFFORTS:

	THIS QTR	YTD
$ VALUES OF SERVICES FROM INDUSTRY:		
IN KIND SERVICES:	2,000	2,000
ACTUAL FUNDS:	n/a	n/a
$ VALUES OF SERVICES FROM GOVERNMENT:		
IN KIND SERVICES:	n/a	n/a
ACTUAL FUNDS:	n/a	n/a

OF SIGNIFICANT CONTACTS:

INDUSTRY:	143
ACADEMIC:	23
GOVERNMENT:	17

COMMENTS: A copy of the Trip Report is enclosed.

Marketing Resource Center Feasibility Project